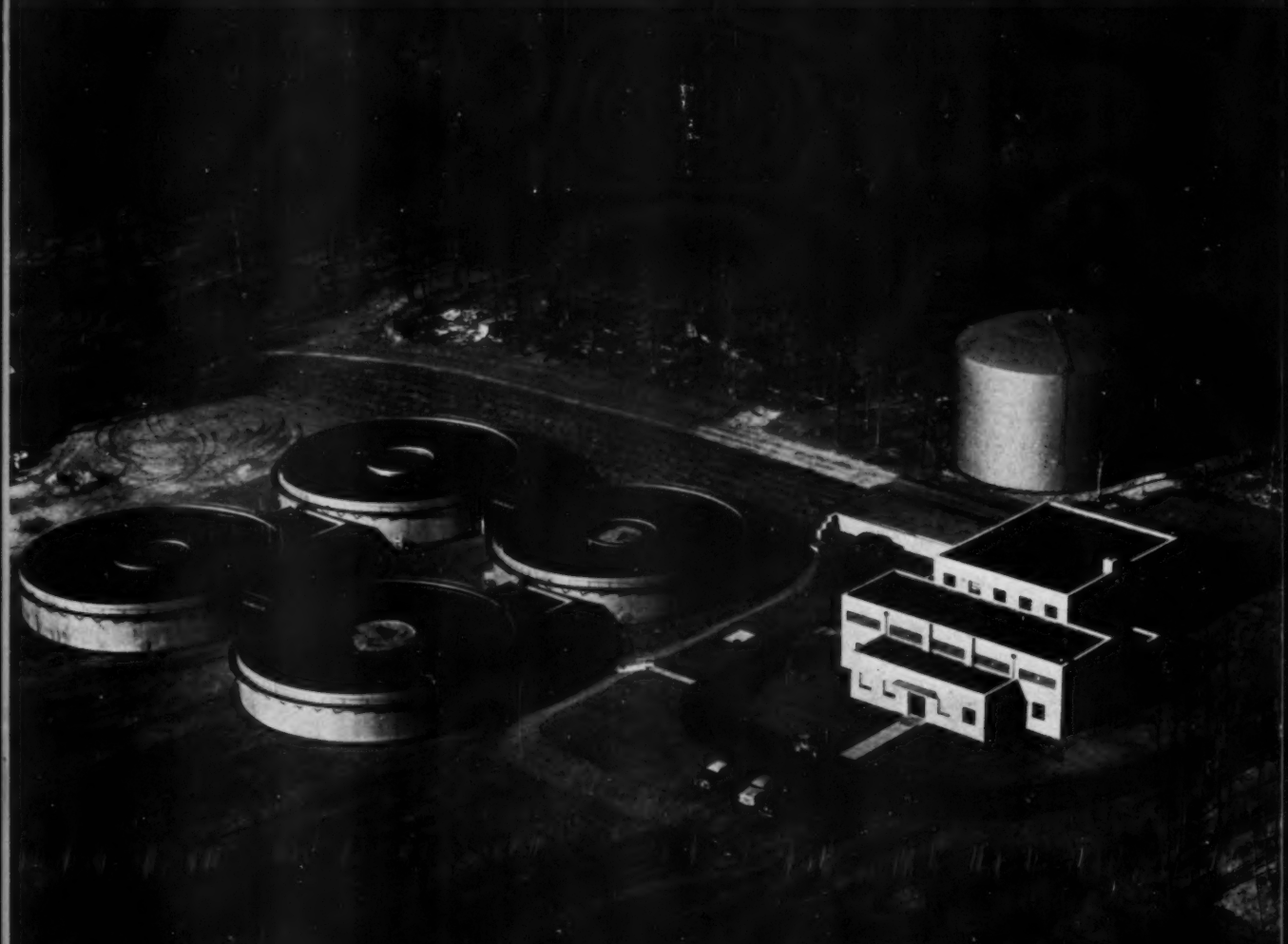
WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

JUNE 1934



Earliest Multiple Water Treatment Unit at Alexandria, Va.

DRILL HERE!

When the point is pinned within an area and Layne engineers say . . . drill here! . . . it is somewhat more than an educated guess.

Behind those two words may be definite knowledge of the water tables and formations of that particular area gained through experience . . . or perhaps geologists working with the latest equipment possibly including electronic resistivity tests have "pinned the point" with all the accuracy that science will permit.

Accurate preliminary exploration is an all important factor in determining subsequent costs. And it is a job for experts. Second guesses are expensive.

Because Layne's service is complete and with undivided responsibility is one reason why so many of the leading industries and largest municipalities have entrusted major ground water development to this organization. But that service is just as important to the smaller farmer, industry or city.

Whatever a water need may be . . . or wherever it may exist, it is wise to first consult your nearest Layne & Bowler associate company. Information on any phase of water development, maintenance or modernization is yours free for the asking.

Layne Associate Companies Throughout The World

Layne

LAYNE & BOWLER, INC.
Memphis 8, Tennessee, U. S. A.

Water Wells • Vertical Turbine Pumps • Water Treatment

Photo by Fairchild Aerial Surveys

NEW BRUNSWICK, N.J.

EQUIPS 8 FILTERS with POROUS UNDERDRAINS

*Information courtesy Mr. Chris C. Condon, Superintendent, New Brunswick Water Dept.

May we send you our popular booklet on porous media? Its 56 pages cover all fields of filtration and diffusion. No obligation, of course. Simply write to the address below.

*A dozen years ago New Brunswick had mushroom strainers in all their gravity filters. They also had an acute case of sand clogging. Dangerously high pressures were often needed to clear the sand. And at best, backwashing was uneven. Mudballs and upset gravel were constant problems.

In 1943, they started to modernize their filters. They installed porous underdrains, using ALOXITE® aluminum oxide plates—one filter in 1943; one in '44; two in '46; two in '48; and two in '50. Today, all their filters have ALOXITE underdrain plates, and their previous difficulties have been eliminated. Backwashing now takes five minutes and only 5000 gallons of wash water per unit, where it used to take 12 minutes and twice as much water.

Our congratulations to New Brunswick on a well planned and executed program of modernization. The low operating and maintenance costs of their porous-plate underdrains should be tremendous assets for years to come.

CARBORUNDUM
Registered Trade Mark

Dept. M-64, Refractories Division

The Carborundum Company, Perth Amboy, N. J.

LOOKING FOR A SLOW, STEADY SOURCE OF CHLORINE?

USE HTH TABLETS

The unique properties of HTH Tablets make them the ideal chlorine carrier for many applications. When added to water, the HTH Tablets go to work immediately, but instead of creating a momentary high chlorine residual which may be rapidly dissipated, they provide a steady supply of available chlorine over a long period. Thus, they are most practical and economical where a chlorine residual must be maintained.

Currently, HTH Tablets are finding application in the following important sanitation jobs:

- Sanitizing newly laid pipe lines and new wells.
- Destroying algae; controlling bacterial growth in spray ponds, reservoirs, basins, etc.
- Disinfecting swimming pool water.
- As a sanitizing agent and algaecide for use in sand filters.
- Destroying offensive odors originating in stagnant ponds, ditches, etc., especially those subject to seepage from septic tanks.
- Preventing the breeding of mosquitoes, flies and other insects.
- Miscellaneous sanitation, deodorization and similar uses.
- Sewage disposal plants—disinfecting of effluents, odor control, B.O.D. reduction.

Get complete information from your HTH supply house or write:

MATHIESON

MATHIESON CHEMICAL CORPORATION
Mathieson Industrial Chemicals Division
Baltimore 3, Maryland

Containing not less than 70% available chlorine, HTH Tablets are easy to use and completely safe. They are packed in 100-lb. metal drums and convenient cases of nine 7½-lb. cans.

2357

HTH TABLET HYPOCHLORINATION
Write for full information on this efficient new chlorination method.

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

COMING ARTICLES

A Guide to Legal Problems in Water Works Operation.....*Murdoch*
Novel Design of Water Distribution System for Arctic Regions.....*Page*
Longtime Experience in Water Well Maintenance.....*Oden & Smith*
Water Works Valves—Selection, Maintenance & Operation.....*Kauffman*
Sewage Treatment 600 Feet Below Sea Level.....*Peter*
Microstraining of Sewage Effluent at Baltimore.....*Keefer*
Financing Sewage Treatment Works on Sound Basis.....*Duvall*
Operating Small Water Works: Materials & Equipment.....*Clark*
Experimental Trickling Filters for Treating Organic Wastes.....*Vogleretal*
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In two continuing series of articles
"WATER WORKS PRACTICES" are discussed by *Dr. George Symons*
"SEWAGE WORKS PRACTICES" are discussed by *Prof. Don Bloodgood*

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VALLEJO, CAL.

Fleming Hill Water Treatment Plant

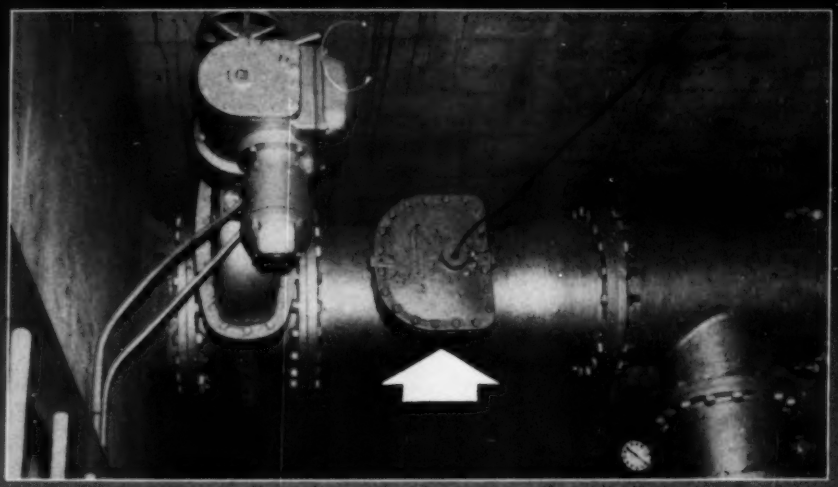
(COMPLETED IN 1953)

KAISER ENGINEERS
DIVISION OF
Henry J. Kaiser Company
Consulting Engineers
OAKLAND, CALIFORNIA

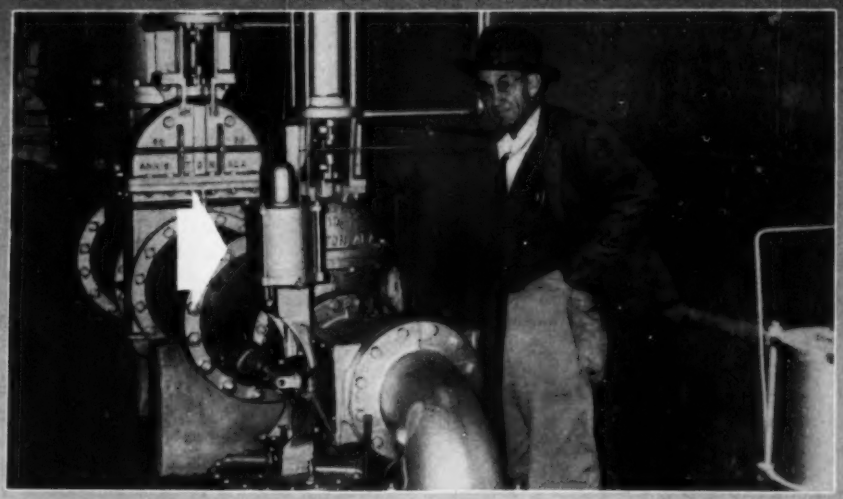
A major element of Vallejo's new six million dollar water supply system is this 14 MGD Water Treatment Plant, built to meet the needs of this expanding industrial city. The facilities include two hydraulic-jump flash mixers, two slow mixing channels, six flocculation tanks, six sedimentation basins, and twelve rapid sand filters. An interesting feature of the plant is its reclamation basin which reclaims wash water for subsequent recirculation through the treatment process. Sludge is lagooned and dried for park use.

Mr. T. D. Kilkenny, Vallejo City Engineer, and Mr. H. L. Thackwell, Consulting Sanitary Engineer for Kaiser Engineers, cooperated in the design and engineering of this attractive plant. Its modern controlling and metering equipment, installed by Walsh Construction Co. and Hastorf-Nettles, Inc., includes: Builders Master Rate Control (a simple, pneumatic system), super-accurate Omega Chemical Feeders and Slakers (arranged for automatic-proportional Chronoflo control); also Builders Venturi Tubes, and Builders Chronoflo Telemeters and Summators. For further details on Builders Meters and Controls and Omega Feeders installed at the Fleming Hill Water Treatment Plant, address Builders-Providence, Inc., Providence, Rhode Island.

Messrs. Kilkenny and Thackwell at one of the six filter operating tables which employ Builders Loss-of-Head and Rate-of-Flow Gauges and Filter Operating Equipment. Each table serves two filters.



Looking down on 24" Builders Propeloflo Meter showing cable which drives remote Totalizer-Indicator-Recorder. This Meter is of particular interest because it meters the flow both in and out of the Vallejo-Swanzy Reservoir.



Maintenance Supt. "Pop" Alley standing beside one of the Builders 10" Model RCE Filter Rate Controllers. Arrow points to power cylinder which positions the Controller in response to the Pneumatic Master Rate Control.

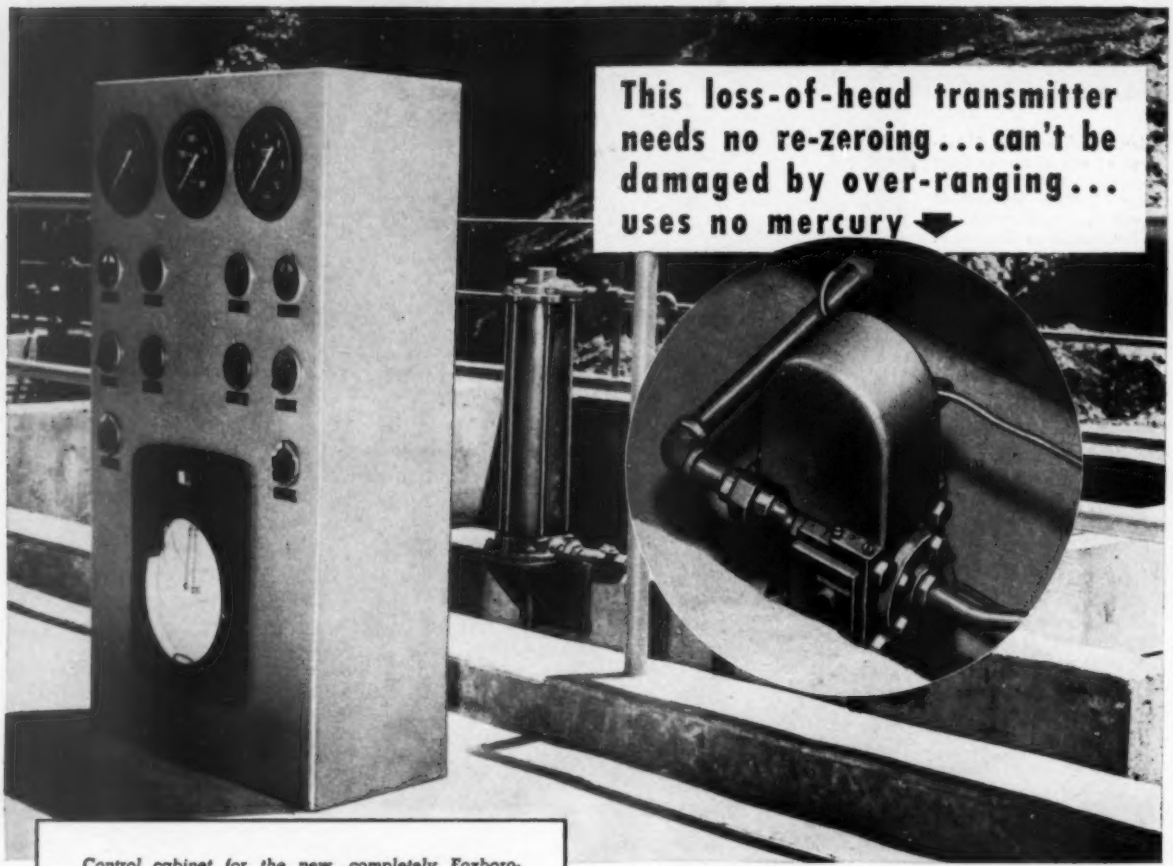
BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

BIF METERS FEEDERS CONTROLS

SLICKEST WAY YOU EVER SAW TO SAVE MAINTENANCE TIME!



Control cabinet for the new, completely Foxboro-instrumented plant of the North Marin County Water District. Two outside gauges at top of panel indicate d/p Cell measurement of loss-of-head. "Easy, economical operation plus neatness" are outstanding advantages of d/p Cell Transmitters cited by plant. Other controls on panel are for effluent rate and backwash. Consulting engineers: Clyde C. Kennedy, San Francisco.

The new water treatment plant of the North Marin County Water District, Novato, Calif., is realizing substantial maintenance savings by using Foxboro d/p Cells to measure and transmit loss-of-head.

The d/p Cell* Transmitter is *designed* to give trouble-free performance. There's no pulley-and-cable arrangement to get out of calibration . . . no mercury system, sensitive to backwash and sand. It's a compact, weatherproof transmitter that detects loss-of-head pressure differential across its tough metal diaphragm . . . converts measurement to proportional pneumatic signal for the indicating receiver. And it's available to measure from 25" to 800" of water in widely adjustable ranges.

Find out how this rugged, reliable transmitter can save time and money in your plant. Write for detailed information on the Foxboro d/p Cell.

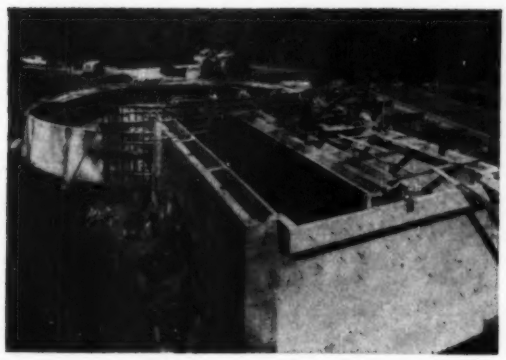
*Trademark

THE FOXBORO COMPANY, 896 NEPONSET AVE., FOXBORO, MASS., U. S. A.

FOXBORO REG. U. S. PAT. OFF. d/p cells

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

Here's how you can stop Sewage Corrosion before it starts!



Corrosive acids, alkalis and salts won't ever get a chance to eat up this sewage settling tank! It's being coated with *Pitt Chem* 103—the coal tar coating that stands up to punishment no ordinary paint can handle.

Pitt Chem Cold Applied Coatings give you three unique advantages:

1. They out-last ordinary paints by many times. Yet they cost no more per gallon.
2. They're easy and economical to apply. Your own men can learn how to apply them in a few minutes.
3. *Pitt Chem* forms a tight, lasting bond with metal, masonry, cement and stone.

It all adds up to this fact: *No other material does such a complete job of protection at so little cost.* ● Why not call in a Pitt Chem corrosion engineer to survey your sewage corrosion problems. There's no cost or obligation.

W&D 3046

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
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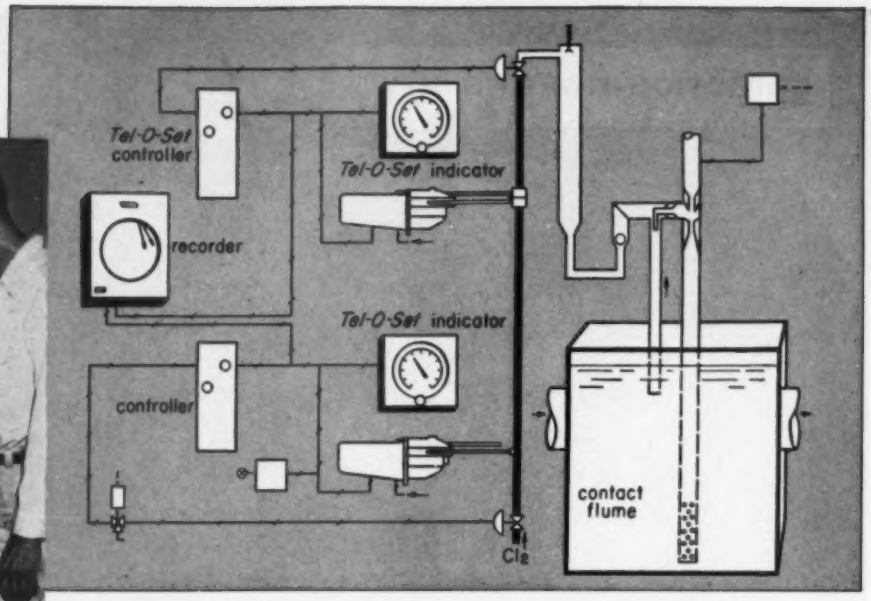


Diagram shows elements of the chlorination control system. Miniature ***Tel-O-Set*** *instruments on the panel show instantaneous pressure and flow values, while the two-pen circular chart instrument records these two variables and integrates chlorine flow.*

Engineered instrumentation *improves water treatment*

THE SIMPLE, practical method of controlling chlorination used at the Corpus Christi filtration plant exemplifies how modern instrumentation can automatically regulate difficult treatment processes. Two *Tel-O-Set* pneumatic control systems team up on this installation: one controls chlorine pressure and the other regulates flow. Together they hold chlorine feeding accurately at the required dosage, under widely varying water demand that reaches forty million gallons per day. The complete instrumentation functions continuously with minimum attention by plant operators, and needs practically no maintenance.

A key element in *Tel-O-Set* systems is the Differential Converter. This mercuryless manometer gives quick, precise response . . . is unaffected by the pure, dry chlorine . . . and is equally applicable to a host of other flow, pressure or liquid level measurements on a variety of fluids.

Whatever your specific problem may be, engineered instrumentation by Honeywell can give you an effective, economical solution. *Tel-O-Set* systems are composed entirely of interchangeable components —and are priced the same for all available components. At your service is a broad line of measuring and controlling equipment, implemented by extensive Honeywell experience in all types of processes used for treatment of water, sewage and industrial waste.

Your nearby Honeywell sales engineer will be glad to discuss your applications with you and your consulting engineer. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

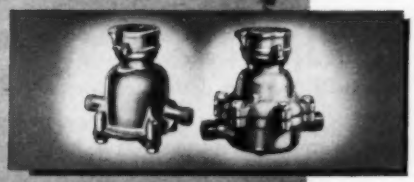
● **REFERENCE DATA: Write for Bulletin 7302, "Instrumentation for water, sewage and industrial waste treatment."**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

WATER is vital...



BADGER meters conserve it!

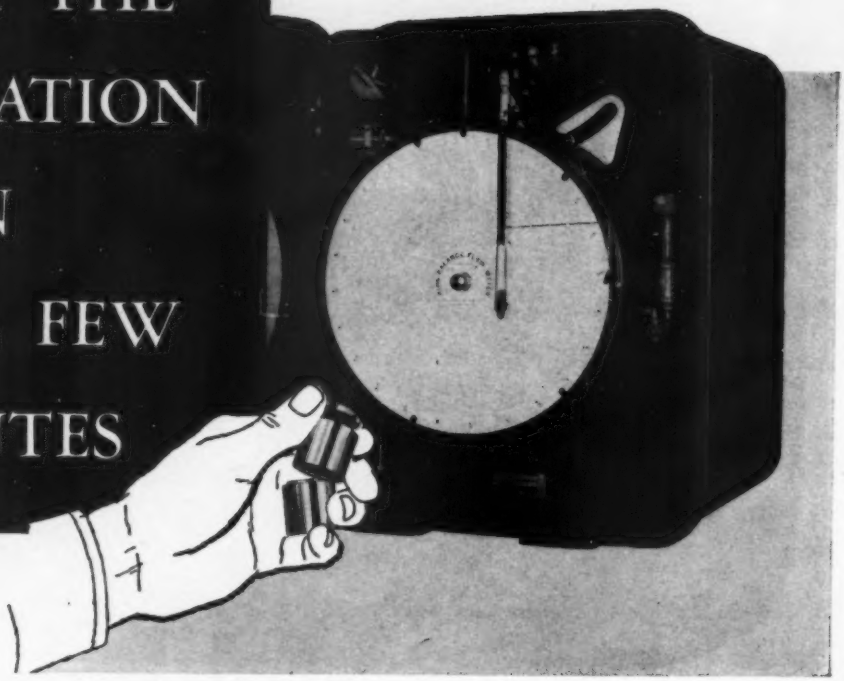
More than 25 million acres of crops must be irrigated to provide America's food supply. The Badger water meters used in thousands of communities throughout the nation help save water for this vital need . . . measure water accurately for homes and industry . . . provide a precise check on water usage and waste. With their outstanding record of performance, Badger meters have won the praise of waterworks men everywhere... are known as the meters that save water, work, money!

BADGER WATER METERS

BADGER METER MFG. CO., Milwaukee 45, Wisconsin

"Measuring the water of the world"

CHECK THE CALIBRATION IN JUST A FEW MINUTES



A routine check of the calibration of any Hagan Ring Balance Meter takes just a few minutes. One man can make the check, and he only needs the calibrated dead weights furnished with the meter.

The check can be made with the measuring element under full static pressure, and without requiring a manometer or other cumbersome testing equipment.

The procedure is simple. Equalize the meter, hang calibrated weights on the ring element, and compare the pen arm position with the total dead weight used.

The ease and simplicity of the dead weight method makes meter checking an easy operation, instead of a real chore.

The Hagan Ring Balance Meter design includes many other advantages, such as these:

- No stuffing boxes or pressure-tight bearings to leak or to add friction.
- Mercury level is not critical.
- Full scale differential with any ring is adjustable over 7:1 range.
- Sensing elements are interchangeable for full scale differentials from 1″ to 420″ WC.
- Pneumatic or electric signal transmitters are available for remote recording or for automatic control purposes.
- Simple automatic compensation for such factors as fluid density, pressure or temperature is a standard attachment.
- Two rings, measuring separate quantities, can be mounted in a single meter housing. Individual measurements can be recorded separately, as well as added or subtracted.

We will be glad to suggest the metering equipment best suited for improving an existing installation, or for extensions and new construction.

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Hagan Corporation

HAGAN BUILDING, PITTSBURGH 30, PA.

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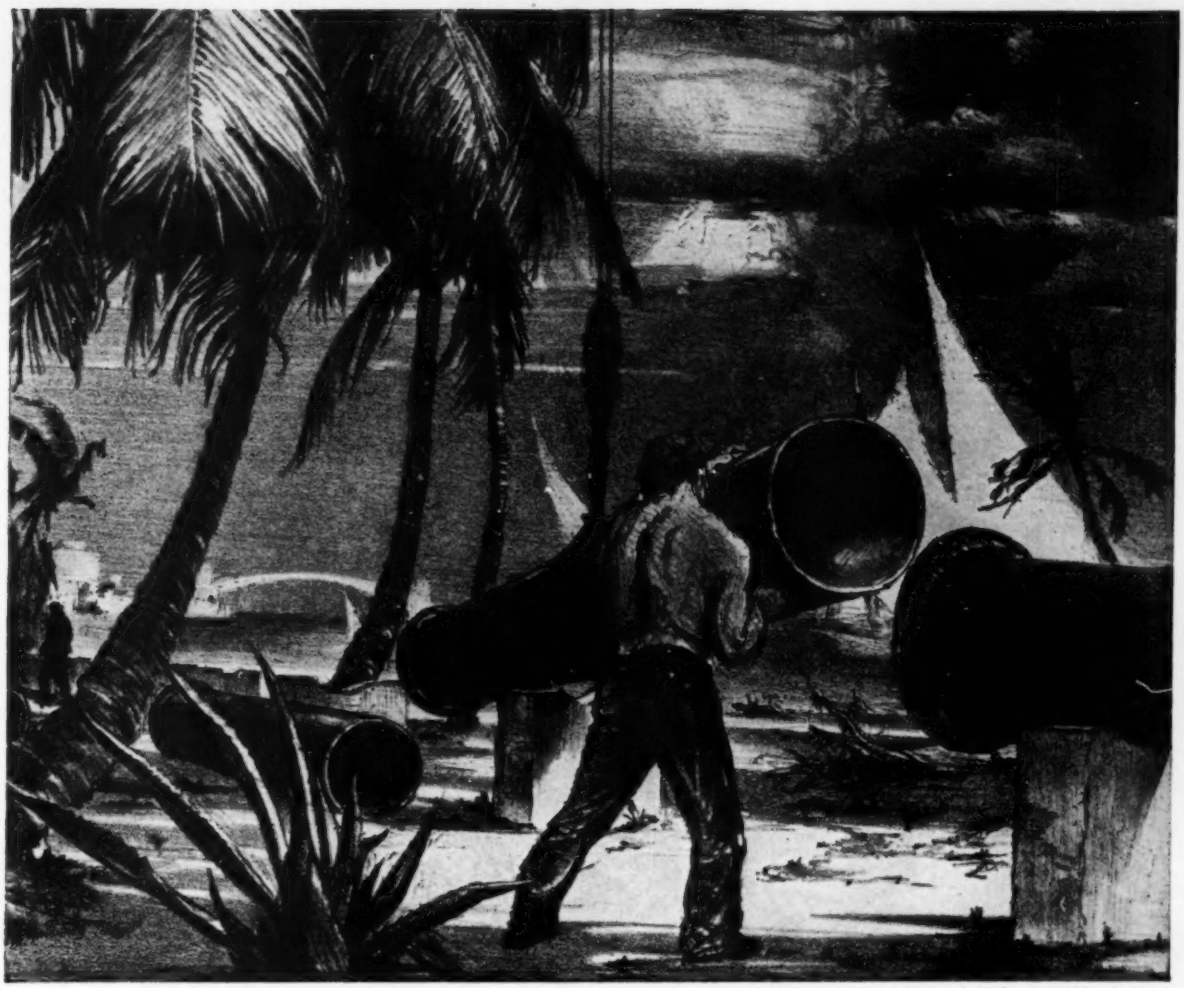

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WHEN THE GROUND is unstable or a definite grade has to be maintained cast iron pipe is frequently laid on piers or pile bents. Whether above ground or underground there are installations of cast iron pipe with continuous service records measured in generations.

We are well equipped to furnish your requirements for cast iron pipe and fittings made in accordance with American Standard, Federal and American Water Works Association specifications. U. S. pipe centrifugally cast in metal molds is available in sizes 2- to 24-inch and pit cast pipe in the larger sizes with bell-and-spigot, mechanical, flanged or other types of joints.

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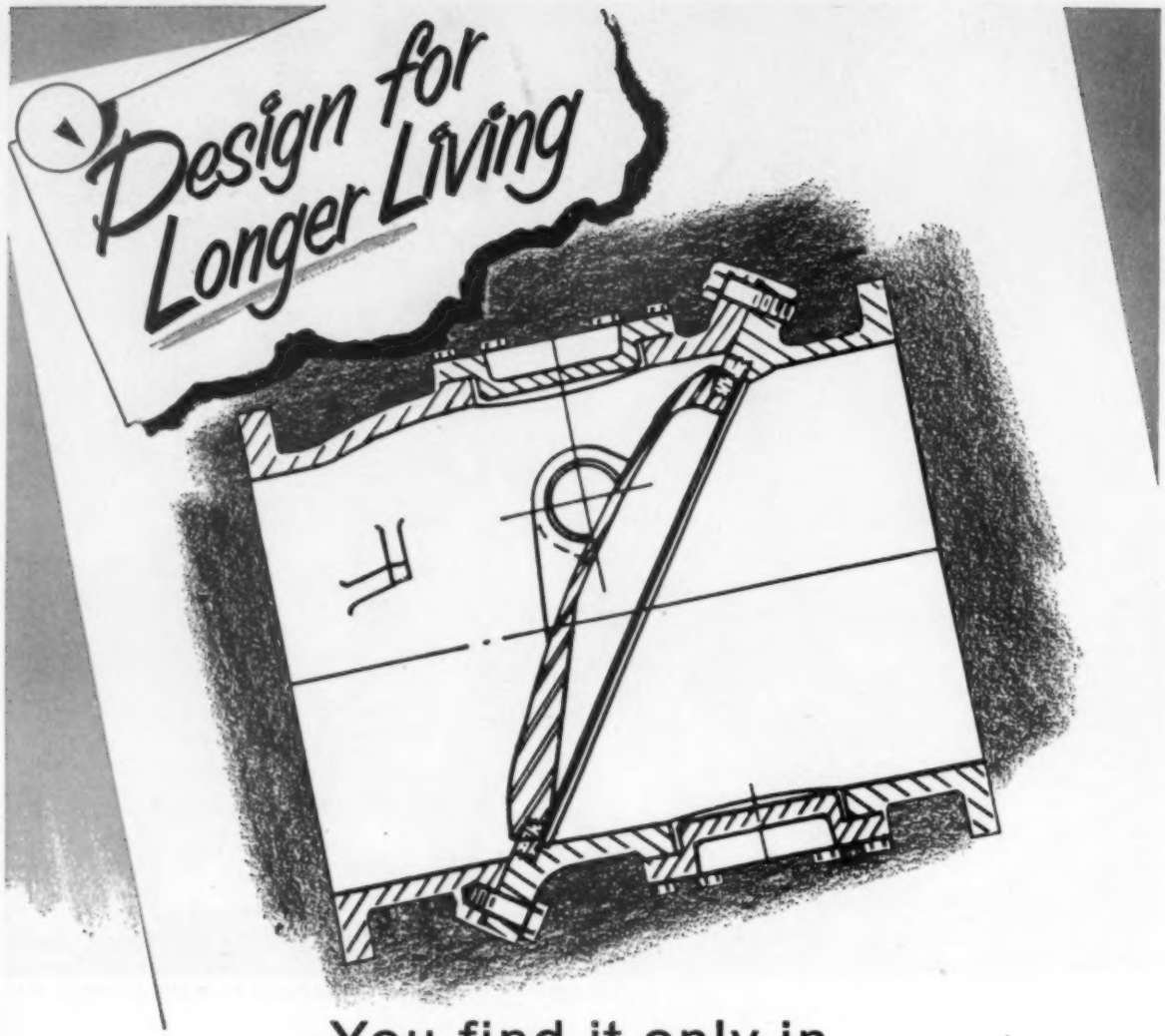
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE



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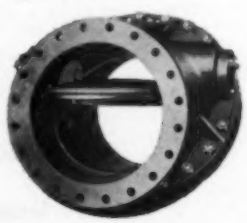
CHAPMAN'S
Tilting Disc CHECK VALVE

Here you can see the specially designed *airfoil section* of the disc in the Chapman Tilting Disc Check Valve . . . and you can see how the disc-seat lifts away from the body seat when opening (and drops into contact when closing) with no *sliding or wearing of the seats.*

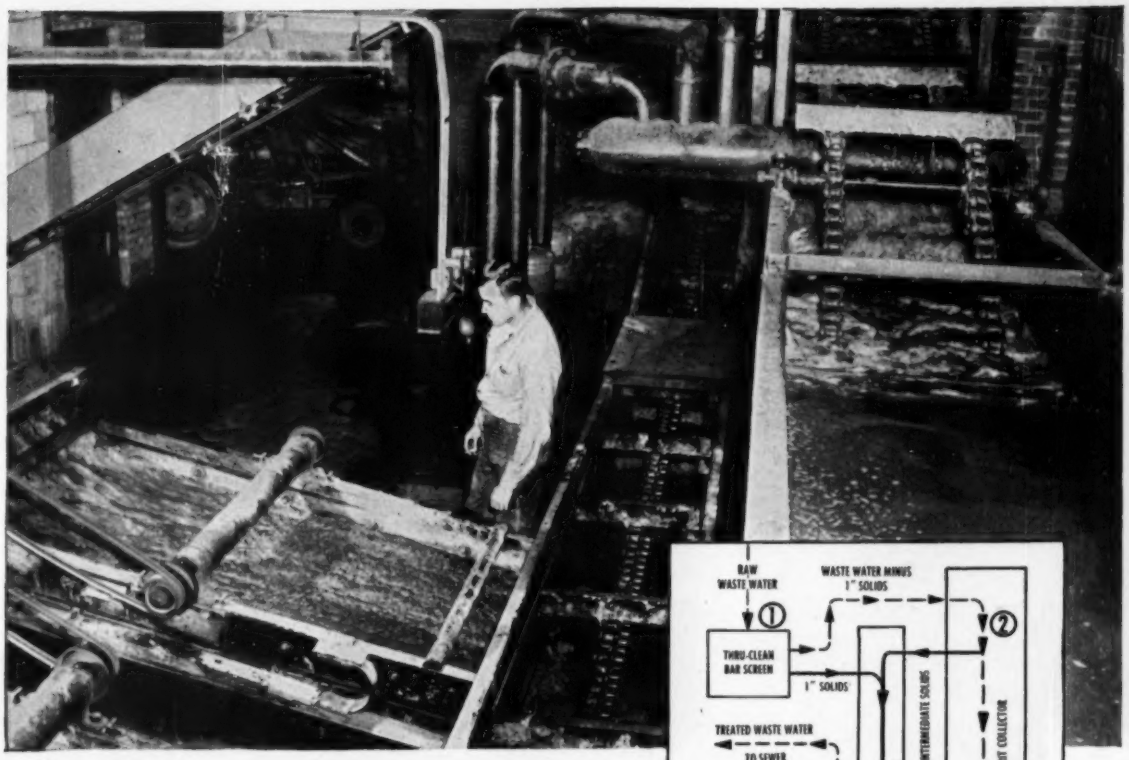
Under usual piping arrangements this unique designed disc won't slam . . . just cushions itself to a quiet closing that does not even jar the line.

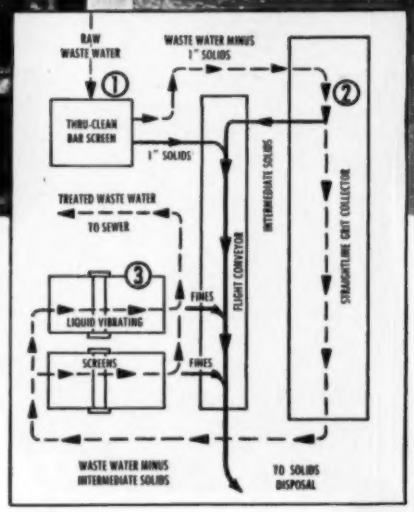
And this balancing is the reason why Chapman Tilting Disc Check Valves greatly reduce head-loss over standard designed swing-type checks . . . as proven by tests in leading engineering schools and by actual performance in the field.

Available in iron or steel. Complete test data is given in Catalog No. 30–write for your copy now.



The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS





Lakeside's waste water passes through a Link-Belt Thru-Clean Bar Screen (1), where over-1-in. solids are removed and chuted to the Link-Belt Flight Conveyor. The effluent next goes to the Straightline Grit Collector (2). Here grit and canning wastes that settle out are discharged to the flight conveyor. The water then flows over two Link-Belt Liquid Vibrating Screens (3), where the last of the objectionable solids are separated and the waste water is piped to the sewerage system.

Here's how one plant cleans up its waste water

Compact, efficient LINK-BELT treatment equipment installed at Wisconsin cannery

LIKE many other plants, Lakeside Packing Co. of Manitowoc, Wis., had a problem of how to remove waste from its wash water before discharging it into the municipal sewerage system. And, just as many others have done, they called in Link-Belt engineers.

The efficient Link-Belt system now employed removes solids from the water in three stages at a peak rate of 24,000 pounds a year. This waste is trucked away to be used as fertilizer and feed.

There are other benefits of a Link-Belt waste treatment system. Your waste water may be carrying valuable material down the drain or clogging your sewers. No matter what your problem, Link-Belt experience and equipment assure the system best suited to your needs. Call the Link-Belt office near you for complete information.

13,482

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

2 New Services from Crane

How to Choose the Right Valve for Each Piping Job

HOW TO GET THESE FREE HELPS

Easiest way: phone your local Crane Representative—let him schedule a film showing for your group and supply the "take-home" handbooks. If more convenient, just drop a line to the address below.

Men responsible for specification, operation, and maintenance of industrial piping systems will get a real "refresher" from these new Crane customer services. Both film and handbook deal with the common problems of matching up valve characteristics and specific flow control needs for the most efficient result.

Following a review of basic valve types—gate, globe, angle, and check—variations in design of functional parts, and the effects on serviceability are discussed. All vital elements—disc and seating—disc-stem connection, bonnet joint, stem operation, etc., are covered. The motion picture stimulates high interest by developing a hypothetical case involving strong differences of opinion on valve selection. The manual—intended for distribution at film showings or for independent use—provides a lasting reference.

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The most complete line of corrosion resistant coatings available anywhere

Field service backed by an organization SPECIALIZING in corrosion control

The service life of your equipment—the efficiency of your production schedules — the ultimate value of your investment and maintenance dollars — all are vitally dependent on the continuing performance of the protective coatings specified in your plant. Thus, success or failure of your coatings can mean the difference between tremendous losses or substantial savings.

To assure coating performance that provides long-lasting, low-cost protection, two steps are absolute essentials, right from the start. You need the right coating for each specific exposure, and it must be applied properly if it is to yield maximum benefit.

AMERCOAT ELIMINATES THE GUESSWORK—MINIMIZES MAINTENANCE COSTS

First of all, AMERCOAT provides the right coating for the particular problem. From the complete AMERCOAT line, it is possible to provide specific coatings for specific exposures to achieve specified protective performance.

In addition, you receive the added value of AMERCOAT's conscientious service follow-through backed by an organization SPECIALIZING in industrial corrosion control. With the assistance and on-the-spot advice of a trained representative, you get the best possible application through proper attention to surface preparation and correct coating techniques.

Investigate AMERCOAT now. It's your surest way to effective, long-term corrosion control. An experienced representative is near you to serve you. For complete details write today.

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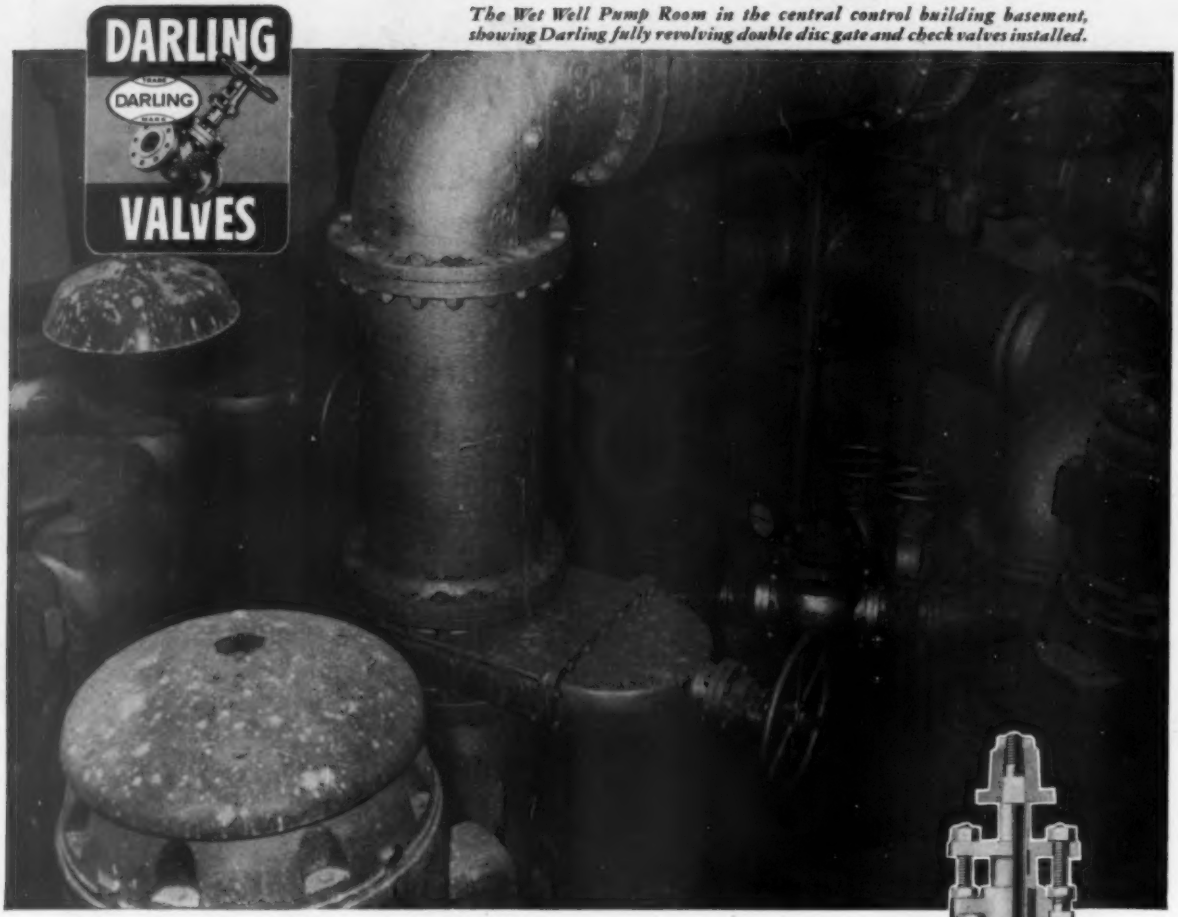
JACKSONVILLE, FLORIDA
HOUSTON, TEXAS



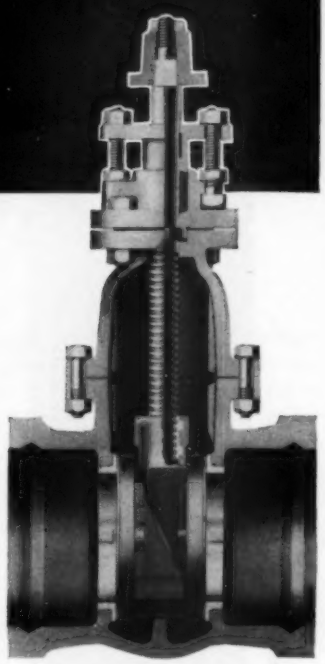
The Wet Well Pump Room in the central control building basement, showing Darling fully revolving double disc gate and check valves installed.

DARLING VALVES in Bethlehem's $5,000,000 sewage treatment plant

THIS new Sewage Authority settling plant, with maximum capacity of 25,000,000 gallons a day, handles the sewage load from 128 miles of Bethlehem, Pa.'s sewer system.

Unique Valve Principle—Darling gate valves, in the "heart of the plant", are closer to being trouble-proof than any you have ever run across. Darling's fully revolving double disc, parallel seat feature compensates automatically for valve body distortion. Tight closure is assured every time. In addition, wear on parts is less . . . and is uniformly distributed. Darlings last longer, require less attention and maintenance.

Valves For Every Need. In water and sewage plants everywhere Darling revolving double disc parallel seat gate valves are setting records for low-cost service. They are available in a wide range of sizes for all normal and unusual service . . . for pressures up to 1500 pounds. Write for all the facts to . . .

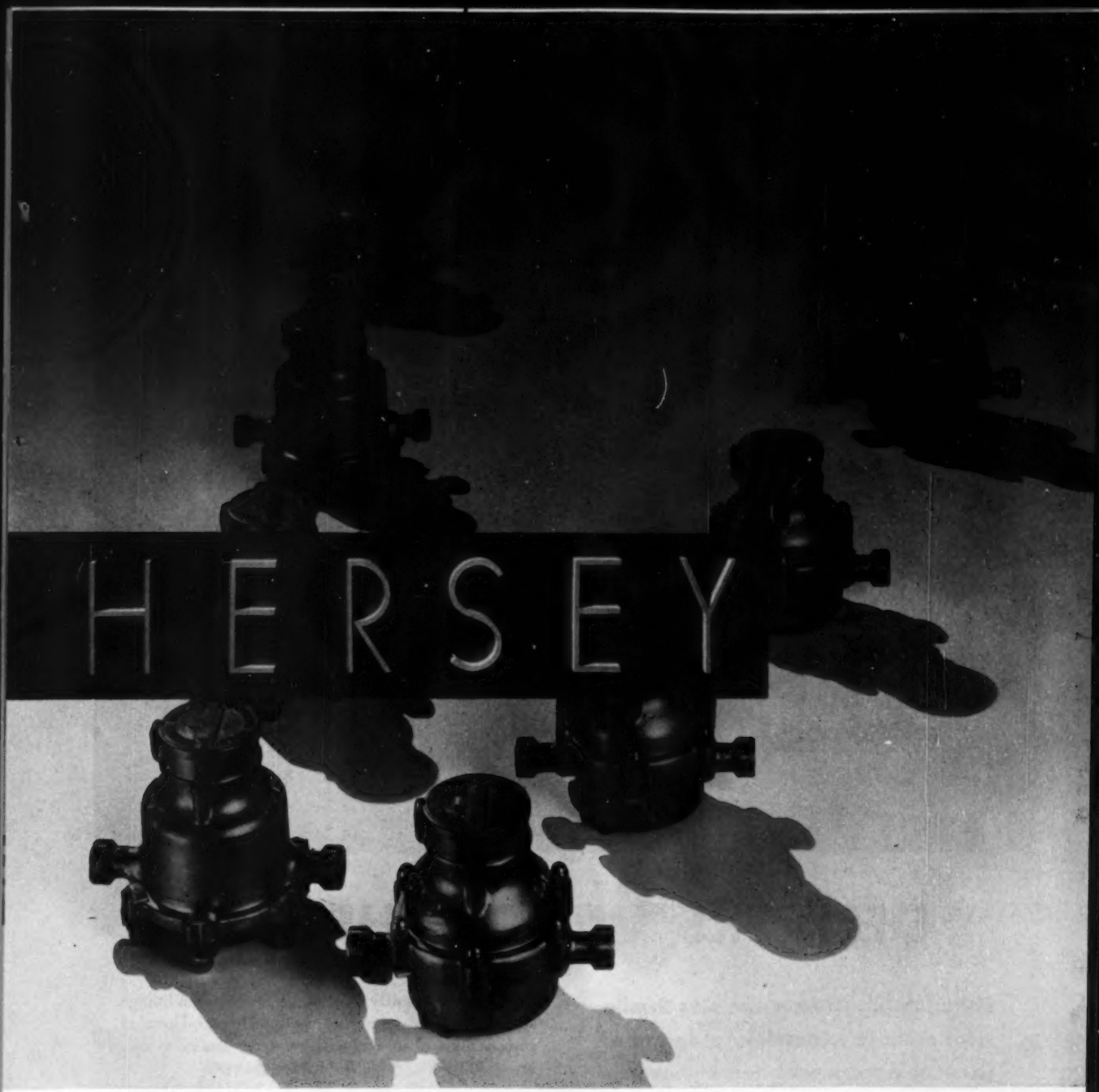


Rugged simplicity is the secret of better operation of the Darling revolving disc principle. Just four sturdy working parts . . . two plain interchangeable no-pocket discs and two husky wedges . . . do all the work. With this foolproof assembly of internal parts, maintenance is easy.

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.



When it comes to lining up your water meter requirements for the coming year, you are surer and safer with

HERSEY WATER METERS

not only for accuracy in registration but also for economic reasons. More water works officials are standardizing on Hersey Water Meters each year. They know.

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

DELIVERS WATER CHEAPER

Philadelphia Dresser-Couples 2-mile steel main in expanding program of general waterworks improvement.

In adding to many miles of Dresser-Coupled steel mains laid since the War, Philadelphia engineers again recognized the outstanding advantages of this type of construction. These twin steel lines meet the needs of central and southern Philadelphia.

Dresser-Coupled steel mains are a sound investment. The beam strength of steel pipe, plus the non-rigidity of both pipe and couplings, assures a husky, flexible, permanently tight line. Glass-smooth linings sustain high carrying capacity. Dresser-Coupled installations fit in well with existing structures . . . are readily adaptable for future changes.

Actual installation is fast and relatively simple. Lighter weight steel pipe is easier to handle. Long pipe lengths mean fewer joints. Small crews, with a minimum of skill, supervision and heavy equipment, make joints faster, surer. The result—lower cost, maintenance-free lines.

BE SURE **you get the *best* line at the *best* price. Always put steel pipe and Dresser Couplings in *your* specifications.**

DRESSER® COUPLINGS

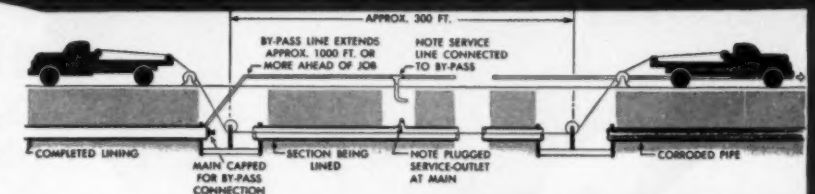
Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: Toronto, Ont.

here *is an earth pipe...*

In remote parts of Asia and Africa where suitable wood and stone are scarce, aborigines made primitive pipes by forming the bowl of clay or damp earth and thrusting into it a long hollow reed for the stem. Chances were good the native absorbed as much dirt and dust as he did smoke. Compared to today's clean, "easy-draw" pipes, smoking was no pleasure!

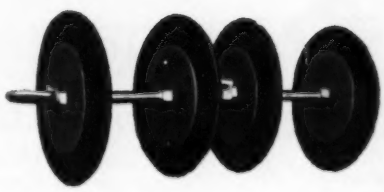
here *is a modern pipe lining operation...*

applicable to water, oil and gas pipe lines . . . using the Tate Process to renew old iron and steel pipe lines "in place"... up to 16" in diameter . . . with only momentary interruption to service while installing bypass sections.


APPROX. 300 FT.
BY-PASS LINE EXTENDS APPROX. 1000 FT. OR MORE AHEAD OF JOB
NOTE SERVICE LINE CONNECTED TO BY-PASS
COMPLETED LINING
MAIN CAPPED FOR BY-PASS CONNECTION
SECTION BEING LINED
NOTE PLUGGED SERVICE-OUTLET AT MAIN
CORRODED PIPE

here is the Steel Scraper which is pulled through the pipe. It dislodges tubercles and incrustation and makes the inside of the pipe clean and smooth.

here is the Rubber Swabber which follows the steel scraper. It drags out all loosened material and makes sure that the inside of the pipe is free and clear.



here is the Tate Process liner. It completes the renewing process by squeezing cement mortar onto the inside of the pipe wall making a smooth, continuous, water-proof lining. Liquids move swiftly without drag. Favorable flow coefficients are restored.

PIPE LININGS, Inc.
(A subsidiary of American Pipe and Construction Co.)
P.O. Box 457, Wilmington, California

☐ Please send complete information on how to obtain new pipe line performance from my old pipe.

☐ Please have one of your hydraulic engineers call on me.

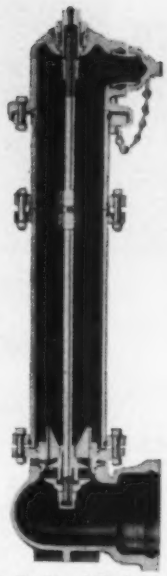
Name _____

Title _____

Company _____

Address _____

City _____ State _____



The R. D. Wood Hydrant can be furnished with breakable flange and stem coupling at extra cost. Both are built to break with a heavy blow. This saves the hydrant itself and makes repair quick and easy.

Solidly Built

• The R. D. Wood Swivel Joint Hydrant is designed to provide maximum reliability at lowest cost consistent with assured delivery of water at full pressure. It is solidly built and of the finest materials. Every point where rust and corrosion might interfere with operation is protected by at least one bronze surface.

The R. D. Wood Swivel Joint Hydrant: All internal parts, including drain valve seat, removable through barrel • all-bronze stuffing box • completely revolving head • compression-type valve, cone shaped to prevent water hammer • automatic drain valve • bronze main valve seat screws directly into elbow with straight, not tapered threads • mechanical-joint pipe connections if specified.

R. D. Wood Swivel Joint Hydrants

Public Ledger Building, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

WRIST-ACTION DIPPER GIVES NEW ANGLE TO TRENCH DIGGING, ADDS 50% MORE POWER!

Note how wrist action brings dipper mouth in "face-up" position — helps keep big loads from spilling. Wrist-action dipper is available in 18-in. and 12-in. dipper widths.

BUCYRUS-ERIE OFFERS another outstanding feature in dragshovel performance — the wrist-action dipper. Dipper is hinged at lower end of dragshovel handle and rotates in a vertical plane through an arc of 65 degrees, from a position 25 degrees ahead of handle to 40 degrees behind it.

Wrist action permits operator to vary the dipper's position so that dipper teeth bite into ground at best digging angle. You not only get bigger loads but also less spillage because dipper can be rotated to best carrying position. Wrist action provides these additional advantages, too:

1. Actual increase of 50% more power delivered at dipper lip — means up to 6 tons of tooth force.

2. The wrist-action Hydrohoe can dig a vertical wall or short, deep trenches (deeper than they are long) with virtually no hand work; dig column footings; cut trenches 12 to 24 inches wide by as much as 13 feet deep.

3. By working wrist action along with boom telescope, operator can pry out rocks and expose buried pipe with far less danger of pipe damage.

4. Wrist-action dipper rotates past stationary door providing automatic ejection of sticky materials — results in more and bigger payloads.

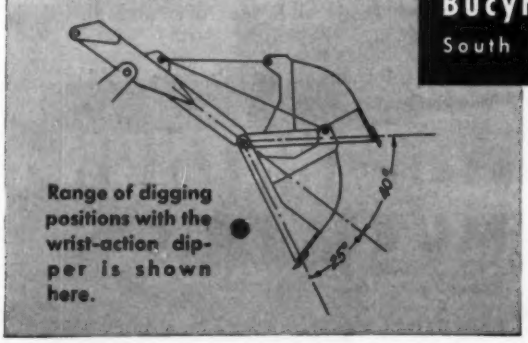
5. Over-all performance is improved by increasing power available at dipper. You have to see this wrist-action dipper in operation to see how it bites in and pries its way through tough clay. It's a real time and money saver.

BUCYRUS ERIE

QUICKLY CONVERTIBLE TO HYDROCRANE IN FIELD

The hoe boom is quickly convertible to crane front end right in the field. With telescoping crane boom this machine has proved outstanding for unloading and laying pipe. Owners say there's nothing like it on pipe handling work.

Get full details on the new Hydrohoe wrist-action dipper and the versatile Hydrocrane. Learn how attachments can be interchanged in minutes. Send coupon today.



Range of digging positions with the wrist-action dipper is shown here.

Bucyrus-Erie Company
South Milwaukee, Wisconsin

Gentlemen:
Please send me details on the new Hydrohoe ☐
Hydrocrane ☐

Name.....

Organization.....

Address.....

City..... State.....

9H54

MUELLER®

IMPROVED AWWA GATE VALVES

Maintenance costs are reduced to a minimum when using Mueller Gate Valves featuring "O" ring stem seals and mechanical joints.

Two "O" rings, replacing conventional stem packing, completely eliminate repacking or retightening and assure a dependable, lasting seal. "O" rings have proven highly effective as sealing devices and do not deteriorate. The space between the "O" rings is filled with a special lubricant to provide permanent lubrication of the stem thrust collar. Exceed AWWA specifications.

Permanent, leakproof joints may be quickly made with just a wrench even in the worst weather. No calking is necessary! The resulting bolted connection is flexible enough to permit deflection in any direction, expansion or contraction, and to absorb vibration — all without leakage! Suitable end gaskets allow a valve of nominal size to be installed on any AWWA class of cast iron pipe.

All Mueller Gate Valves feature Mueller's exclusive "four point contact" disc wedging mechanism and are fully bronze mounted. On special orders, valves will be furnished with all-bronze disc and disc wedging mechanism.

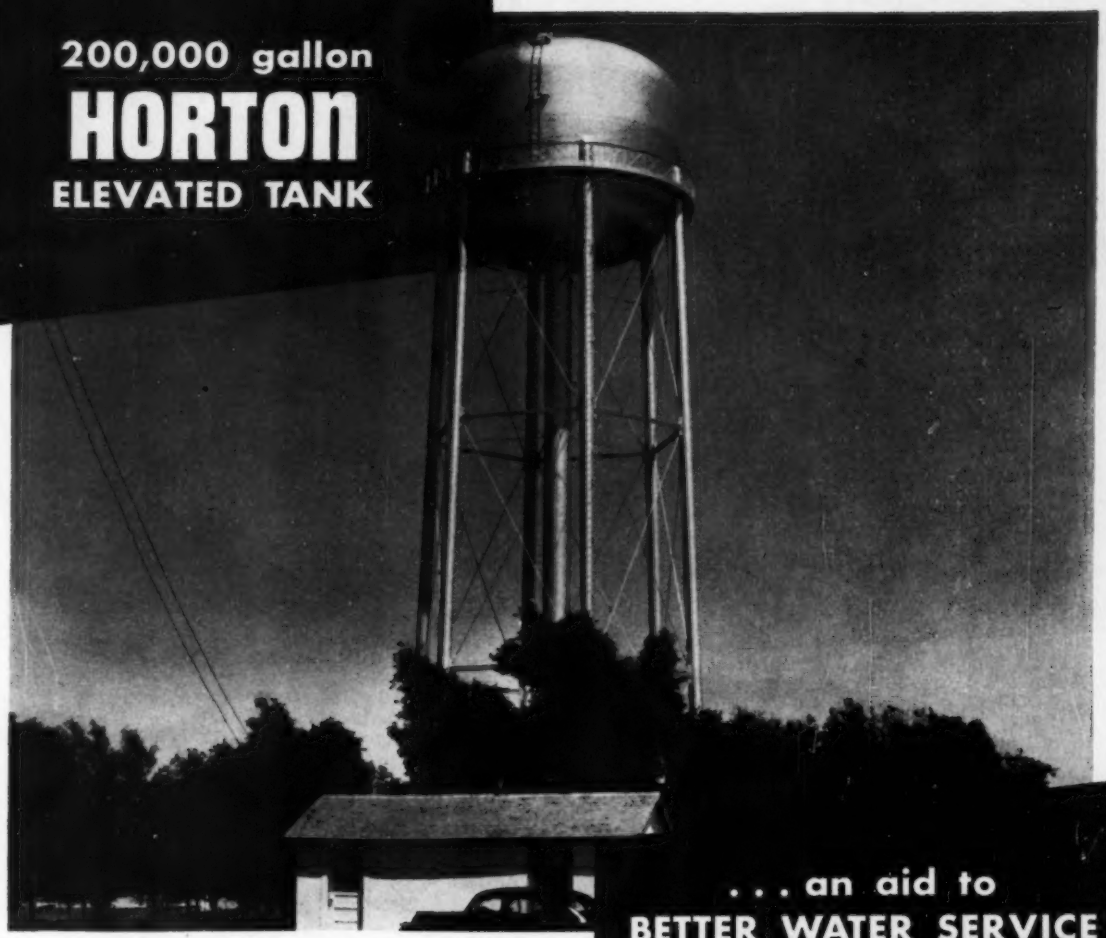
For additional information, consult your Mueller Water Works Catalog W-96 or your Mueller representative.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

200,000 gallon
HORTON
ELEVATED TANK



. . . an aid to
BETTER WATER SERVICE
at Muleshoe

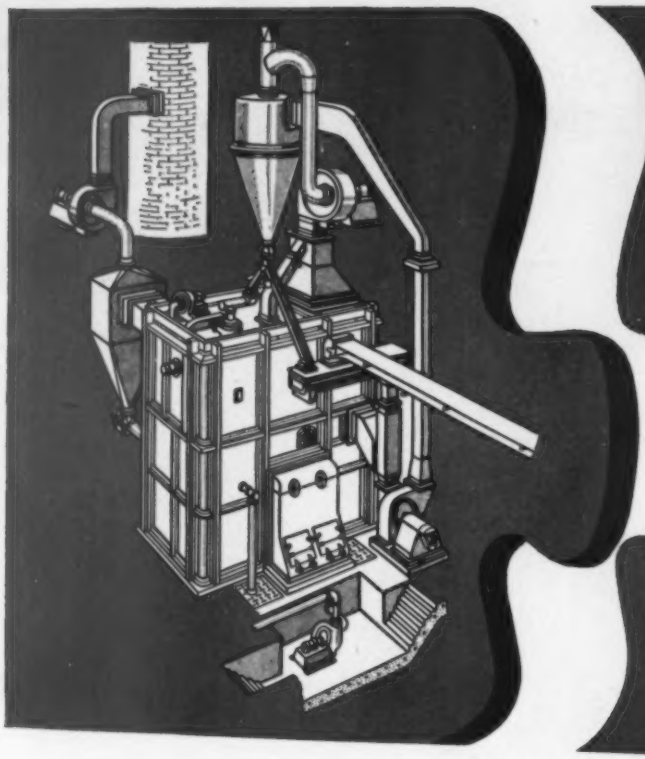
● The installation of the 200,000-gal. Horton® ellipsoidal-bottom elevated tank shown above in the municipal water system at Muleshoe, Texas, brought several important benefits to the community. There is now an adequate reserve of water on hand at all times to meet demands for use in homes, plants or for community fire protection. The elevated tank maintains more uniform pressures in the mains during peak load periods.

If your municipal water system is being outdistanced by population growth, seasonal water demands or other reasons, investigate the possibility of installing a Horton elevated tank helping to solve your problems. Write our nearest office for further information, estimates or quotations. There is no obligation.

HORTON
WELDED STEEL
STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY
Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3	2181 Healey Bldg.	Los Angeles 17	1555 General Petroleum Bldg.
Birmingham 1	1586 North Fiftieth St.	New York 6	3390—165 Broadway Bldg.
Boston 16	1648—201 Devonshire St.	Philadelphia 3	1644—1700 Walnut Street Bldg.
Chicago 4	2198 McCormick Bldg.	Pittsburgh 19	3260 Alcoa Bldg.
Cleveland 15	2262 Midland Bldg.	Salt Lake City 4	550 West 17th South St.
Detroit 26	1551 Lafayette Bldg.	San Francisco 4	1583—200 Bush St.
Havana	402 Abreu Bldg.	Seattle 1	1350 Henry Bldg.
Houston 2	2115 C & I Life Bldg.	Tulsa 3	1646 Hunt Bldg.



the ideal solution to sludge disposal problems

Here is the modern method of sludge disposal – the C-E Raymond System of Flash Drying and Incineration. Continuously, automatically, this system incinerates thickened sludge to a fine ash, free from clinker and unburned materials . . . or flash dries it to fertilizer, containing all of the original fertilizer constituents.

C-E systems now in service are meeting the requirements of both large and small communities – serving equivalent populations from 14,000 to 3,600,000. The list below shows the most recent installations.

C-E Raymond Systems are flexible in layout, highly efficient and fully reliable; they provide for maximum utilization of waste heat. They mean for any community the end of stream or atmospheric pollution resulting from the disposal of sewage wastes.

The services of C-E specialists are available to help you plan for the most practical and economical answer to your sludge disposal problems. For prompt attention, get in touch with one of the Combustion offices listed below. B-669

C-E Raymond Systems installed, under construction or on order since 1945

Installation	Consulting Engineer
Baltimore, Md.	Whitman, Requardt & Associates
Bethlehem, Pa.	Morris Knowles
Bloomsburg, Pa.	Gannet, Fleming, Corddry & Carpenter
Camden, N. J.	Havens & Emerson
Chicago, Ill. (W. Southwest)	Engineering Dept., Sanitary District
Edgewater, N. J.	McClave & McClave
Fond du Lac, Wis.	Jerry Donohue Engrg. Co.
Houston, Texas	Greeley and Hansen
Lansing, Mich.	Drury, McNamee and Porter
Los Angeles, Cal.	Metcalf and Eddy
San Diego, Cal.	Frank Currie
San Francisco, Cal.	Clyde C. Kennedy
Schenectady, N. Y.	Havens & Emerson
Sheboygan, Wis.	Jerry Donohue Engrg. Co.
Washington, D. C.	Greeley and Hansen
Waterbury, Conn.	Malcolm Pirnie
Wyomissing Valley, Pa.	Albright & Friel
York, Pa.	Albright & Friel

COMBUSTION ENGINEERING, INC.

FLASH DRYER DIVISION

1315 North Branch Street
Chicago 22, Illinois

Western Office: 510 W. Sixth, Los Angeles 14, Cal.
Eastern Office: 200 Madison Ave., N. Y. 16, N. Y.

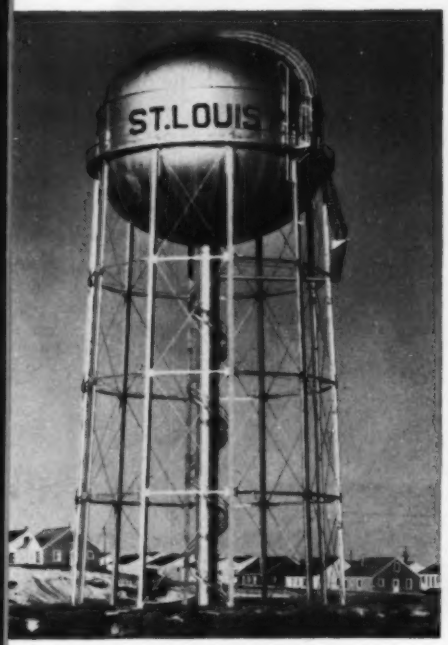
ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

LOW COST STORAGE
IN THE
MILLION GALLON
RANGE

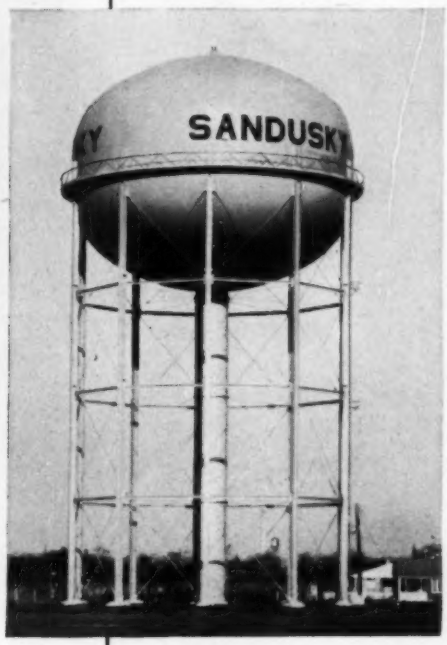
PITTSBURGH-DES MOINES

DOUBLE-ELLIPSOIDAL

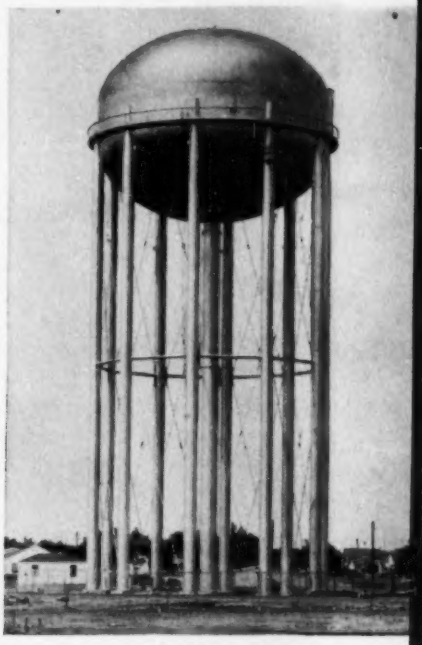
Elevated Steel Tanks



ST. LOUIS PARK, MINNESOTA
Diameter 65 ft.
Head range 48 ft. 5 ins.
H-column tower, 106 ft.



SANDUSKY, OHIO
Diameter 68 ft.
Head range 42 ft.
H-column tower, 81 ft.



AMARILLO, TEXAS
Diameter 68 ft.
Head range 42 ft.
Tubular column tower, 114 ft.

Write for this well-illustrated, comprehensive Catalog of the complete range of P-DM Elevated Steel Tanks, without obligation.

The intrinsic design economy of our famous Double Ellipsoidal Elevated Steel Tank makes this type particularly attractive where low cost with good appearance is a major consideration. Clean cut lines without ornamentation enable savings in construction that are reflected in the purchase price. Fine, simple proportions result in a handsome structure for the community. Let us give you the details on our Double Ellipsoidal and other elevated tank types in a personal meeting, at your convenience.

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25), . . . 3418 Neville Island	DES MOINES (8), ... 919 Tuttle Street
NEWARK (2), . . 218 Industrial Office Bldg.	DALLAS (1), . . . 1223 Praetorian Building
CHICAGO (3), 1222 First National Bank Bldg.	SEATTLE . . . . . 526 Lane Street
LOS ANGELES (48) . . 6399 Wilshire Blvd.	SANTA CLARA, CAL. . . . 625 Alviso Road

The test of a century

F.P.G.

This is Lancaster, Pa., County seat in one of the most highly cultivated farming districts in America.

Bettmann Archive

Old print showing southwest view of Lancaster about 100 years ago.

MODERNIZED cast iron

is the test that tells!

LANCASTER installed cast iron water mains 100 years ago . . . and installs them today.

Lancaster, Pa., has grown in 100 years from about 12,000 population to nearly 65,000 — but it has not outgrown the habit of buying cast iron pipe. From four miles of water mains a century ago, the present distribution system has increased to 105 miles of pipe—all of it cast iron pipe. Services have grown from 2,000 to nearly 20,000.

The word "test" means—"*put to the proof*"—according to the dictionary. Well, 60 utilities have put cast iron pipe to the *proof* for a century—a test to end all tests. They installed cast iron water or gas mains 100 years, or more, ago that are still in service. Yes, the test of a century has *proved* beyond question the long life and low cost per service year of cast iron pipe.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality. And, where needed and specified, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout the long life of the pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

This cast iron water main laid in 1835 by the Bureau of Water of Lancaster is still functioning after 119 years of service.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS OPERATION

G-E Cabinetrol* Panels Are Custom-engineered for Your Exact Specifications

1. **STANDARD COMPONENTS** assure fastest possible production and delivery of your panels. Modern factory techniques speed completion of your order.
2. **YOUR REQUIREMENTS** are followed exactly. Thorough examination and testing assure "job-tailored" performance.
3. **EXPERIENCED G-E ENGINEERS**—working closely with you—design the unit to meet your application.

Cabinetrol panels are not costly, improvised modifications of some other type of control center. These panels form a **standard** low-voltage control system which handles all motor types up to 600 hp from a central location. You get the time-saving and money-saving advantages of standard components which are custom-assembled.

For complete information, contact your nearest G-E Apparatus Sales representative. Or write for the descriptive bulletin, GEA-3856. Section 780-4, General Electric Company, Schenectady 5, New York.

*Reg. trade-mark of General Electric Co.

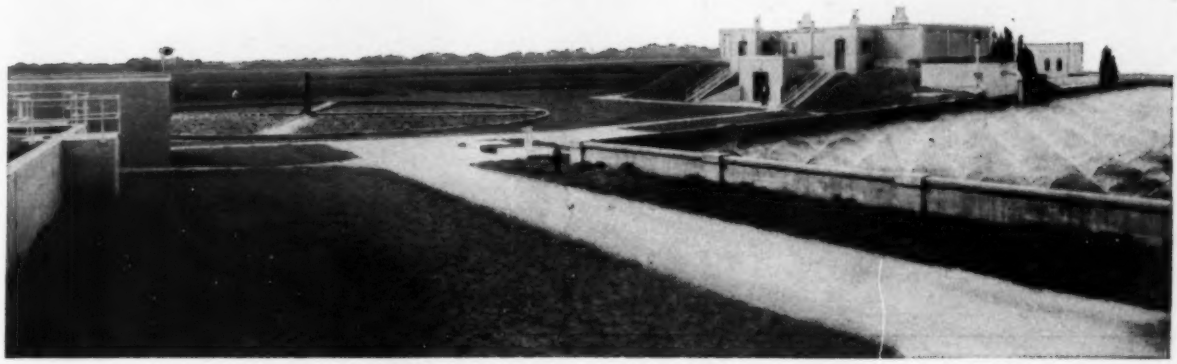
GENERAL ELECTRIC

at Arlington Heights, Illinois . . .

***the plant**—a system built in 1931 consisting of Imhoff Tank and P.F.T. fixed nozzle filter bed.*

***the problem**—population nearly doubled since 1946 . . . how to expand economically to handle heavier loads.*

***the solution**—addition of P.F.T. equipment to make better use of existing structures!*



Plant expanded—older structures utilized

WITH MODERN P.F.T. EQUIPMENT

To increase capacity in the original filter bed, the P.F.T. 16″ trapless siphon was supplemented with a *P.F.T. 20″ trapless siphon*, providing a total of 383 nozzles located on stub laterals of the original distribution system. Results: capacity increased to over 300% applied to the *same filter bed;* greater flow and more uniform distribution without additional use of head!

For additional capacity and more complete treatment, a 120 ft. diameter filter bed was installed and equipped with a *P.F.T. Rotary Distributor.* Handling 3,000 g.p.m., it serves as a *primary* filter ahead of the fixed nozzle filter and may also be used *parallel* with the fixed nozzle filter during storm flows! Five *P.F.T. 8″ Rotary Sludge Withdrawal Valves* control sludge removal from the primary and secondary clarifiers.

The Imhoff Tank was converted to modern sludge digestors, each equipped with *P.F.T. 35′ Floating Covers* for safe gas collection, simplicity of operation and *more complete treatment.* In converting the Imhoff, baffles forming the sedimentation compartment were removed and the outside walls extended 8 feet. Results: "controlled" digestion and greater capacity!

Heat for the new digestors is provided by a *P.F.T. Heater and Heat Exchanger Unit* which is fired by sludge gas. The unit cuts fuel costs by utilizing all sludge gas available, automatically changing to oil only as necessary. Other P.F.T. digestion control equipment includes: *2 Supernatant Selectors with Gauge, Sight Glass and Sampler Units;* various items of *Gas Safety Equipment.*

Pictured in the photograph above are: (left) the primary filter bed with Rotary Distributor, (right center) the converted Imhoff Tank fitted with Floating Covers, (right) the revised fixed nozzle filter.

Further information on Arlington Heights equipment is yours upon request.

Design of plant by / *Consoer, Townsend & Associates, Chicago, Illinois*

P.F.T. first supplied equipment to Arlington Heights in 1911. This early equipment consisted of six 10″ plural alternating siphons to automatically dose sand filter beds. The 1911 plant was designed by W. S. Shields, Chicago, Ill.

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

TRIDENTS ARE BUILT FOR *You*. . . . .

They're built to hold their accuracy longer, so that you are paid for as much as possible of the water you pump.

Built to be easier to repair, so that your shop time and expenses are cut down.

They're designed so that the newest parts fit the oldest meters . . . simplifying your repair parts problems, helping you to get modern performance from your oldest meters.

And they're built to *last*. Tridents as old as 50 years are still in service. The Tridents you buy today will be a credit to your water system for many long years to come.

NEPTUNE METER COMPANY
50 West 50th Street • New York 20, N. Y.

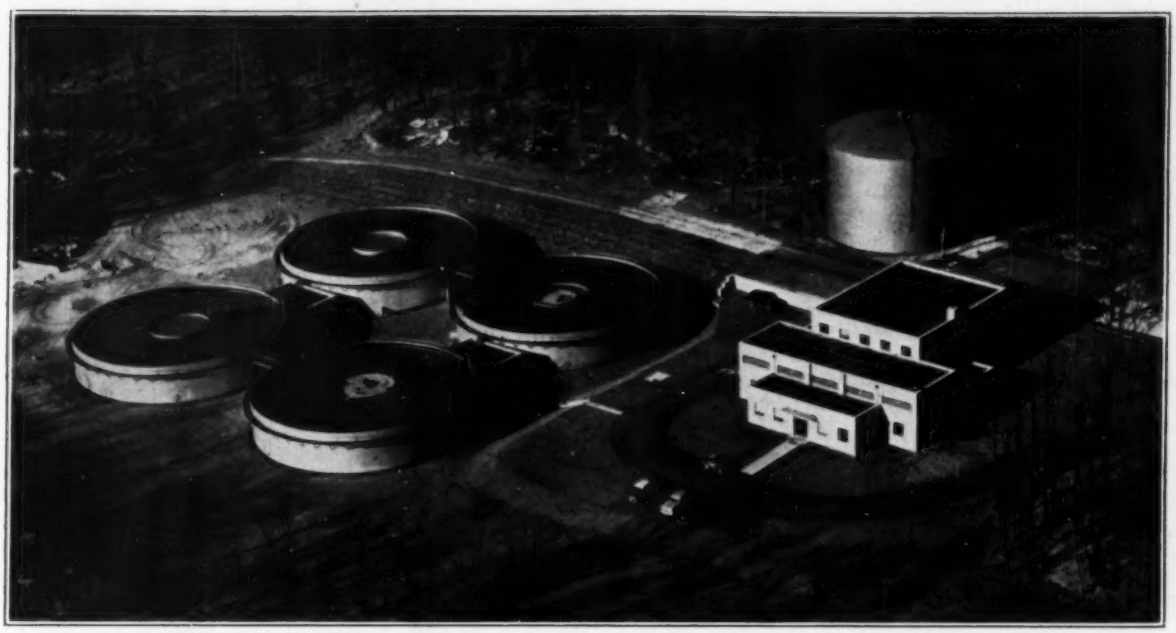
NEPTUNE METERS, LTD.
1430 Lakeshore Road • Toronto 14, Ontario

Branch Offices in Principal American and Canadian Cities

neptune

WATER & SEWAGE WORKS

VOL. 101, NO. 6 • A Scranton Gillette Publication • JUNE 1954



ALEXANDRIA, VA.—Original plant (9 mgd.). Two additional units recently added bring total capacity to 13.5 mgd.

Multiple Water Treatment Units

A Continuing Experience Report

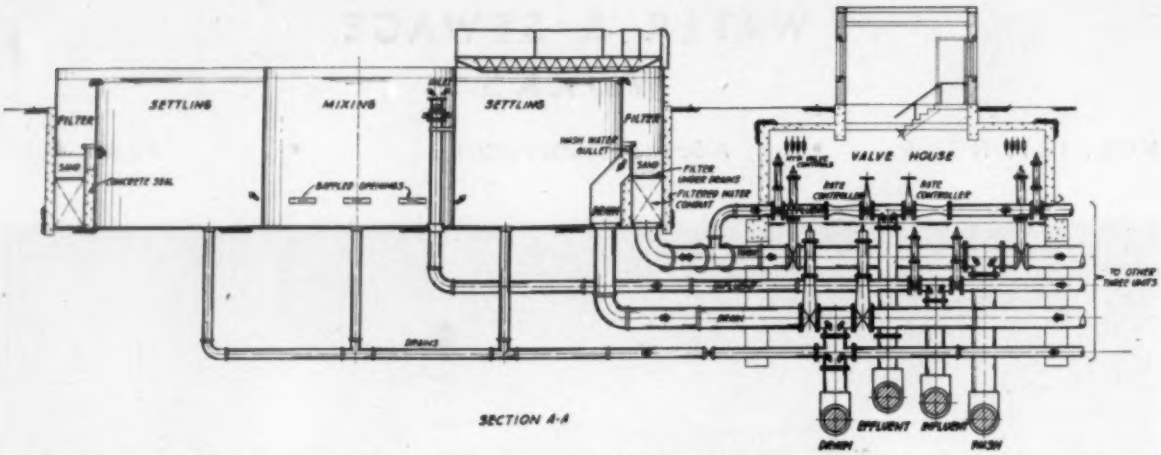
by **E. H. ALDRICH**, *Vice-Pres. & Chief Engineer, Amer. Water Works Service Co., Inc. Philadelphia, Pa.*

NEARLY four years of experience in operating water treatment units combining mixing, settling and filtration in a single structure have continued to demonstrate their efficiency and economy in operation. These multiple units were first developed and installed in the Occoquan Plant of the Alexandria (Va.) Water Co., and have been in service for lesser periods in the Beaver Run Plant of the Municipal Authority of Westmoreland County (Pa.), at Chattanooga, Tenn., and at Ashtabula, O. The installation costs of similar treatment units now under construction continues to be substantially below the costs of conventional plants comparable in size, extent of treatment, and facilities therein provided.

Each treatment unit consists of concentric steel or concrete rings, having a central mixing compartment surrounded annularly by a settling compartment, which is in turn surrounded by an annular filter bed on the outside periphery. In the later installations advantage has been taken of the newest developments in sludge removal equipment and the upward flow-sludge blanket principle of sludge concentration with continuous removal.

New Multiple Units Under Construction

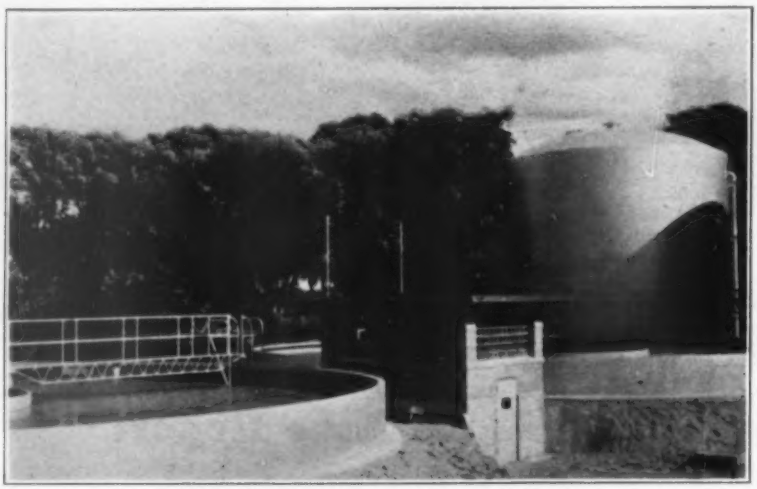
Under construction at the present time are two 2-mgd units at Greenwich, Conn., with continuous sludge removal using Hardinge equipment; two 2-mgd units combining softening with normal treatment for The Citizens Water Co. at Canonsburg, Pa., employing the Dorr Co. Hydro-Treater using upward flow-sludge blanket thickening and continuous sludge removal; a single 2-mgd unit employing the same equipment for iron removal from well water for the Monmouth (N.J.) Consolidated Water Co.; and another single unit



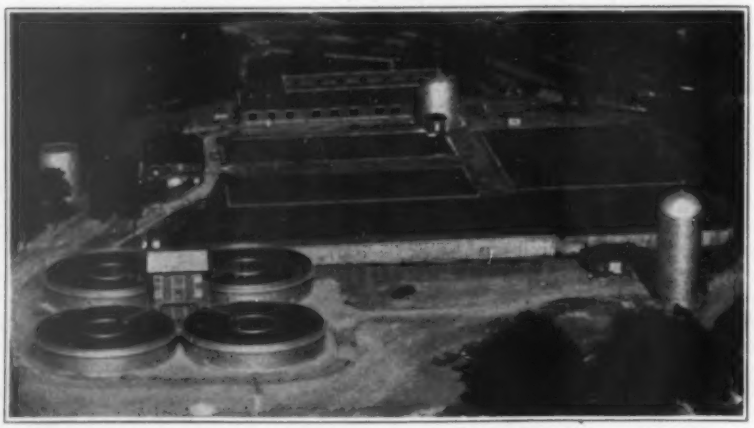
SCHEMATIC SECTION of multiple treatment units. Concentric steel (or concrete) rings provide mixing, settling, and filtration.

for normal settling and filtration for the Riverton Consolidated Water Co. at Lemoyne, Pa. All these plants are expected to be in service in the next few months.

In less advanced stages of design or construction are a 5-mgd extension (two units) to the 10-mgd installation at Chattanooga, Tenn.; a 5-mgd addition (two units) to the plant of the Huntington (West Va.) Water Corp.; a 10-mgd addition (four units) to the East St. Louis (Ill.) and Interurban Water Co.; a two-unit (4-mgd) addition at Kokomo, Ind.; and a single unit (2-mgd) addition at Joplin, Mo. Other installations are in the planning stage, not only for companies under our supervision, but for a number of other plants as well. Following completion of the installations enumerated above, operating experiences will then include many different types of treatment in plants located in the eastern and central part of the country. The water treated will vary widely as to sources and characteristics.



ASHTABULA, OHIO, 4 mgd. capacity plant
Open filters in a cold climate proved satisfactory.



CHATTANOOGA, TENN., 10 mgd. capacity plant of the City Water Company
The old filter plant is in the background.

Standard Mechanism Employed

Treatment units utilizing the principle of combining mixing, settling and filtration in a single structure have been added to the long line of sanitary equipment of The Dorr Co. of Stamford, Conn. Named the Dorrco Aldrich PeriFilter System because of the location of the filter around the perimeter of the pretreatment compartment, it will incorporate any one of three standard Dorr mechanisms. Plain mixing and settling can still be employed where minimum treatment is needed. A Dorrco Hydro-Treater will normally be used as shown in the cutaway view of a typical system comprising two units.

Bartholomew Co. of Dallas, Texas, is the independent representative for these units in the States of Louisiana, Arkansas, Oklahoma, Texas and New Mexico.

Alexandria, Va., Installation

Typical views of several of existing installations are shown. An air view of the original installation at Alexandria shows only four units, but two more units, added in 1952-53,

are located to the left of the original units, bringing the total capacity of the plant to 13.5 mgd. This addition brings out one of the obvious advantages of the unit type of development, wherein additional units can be added easily and economically from time to time as the water demand increases. It is unnecessary to initially overbuild a plant and thus have excess future capacity.

The original Alexandria installation was made in 1949-50 at a unit cost of $78,500 per mgd capacity. This cost included the mixing, settling and filtration unit; central control building, adequate for a plant three times its initial capacity, housing chemical storage and treatment facilities; chlorination facilities; laboratory and office; garage; filter control equipment; clear well, suction chamber, and high service pumping and control equipment. The plant also included a 1.0 mg wash water standpipe which also serves as a balancing reservoir for gravity service. In other words, the installation is a complete plant, excluding supply facilities, for treating and supplying water to the system.

The two additional units and pumping equipment were added in 1952-53 at a cost of $32,300 per mgd capacity, reducing the overall average cost of the 13.5-mgd plant to a unit cost of about $63,000 per mgd. Additional units, to bring the plant to its ultimate capacity of 27 mgd, can be added at a comparable low cost, with a final overall unit cost less than $50,000 per mgd.

BEAVER RUN PLANT, 10 mgd. capacity, Municipal Authority of Westmoreland County, Pa.

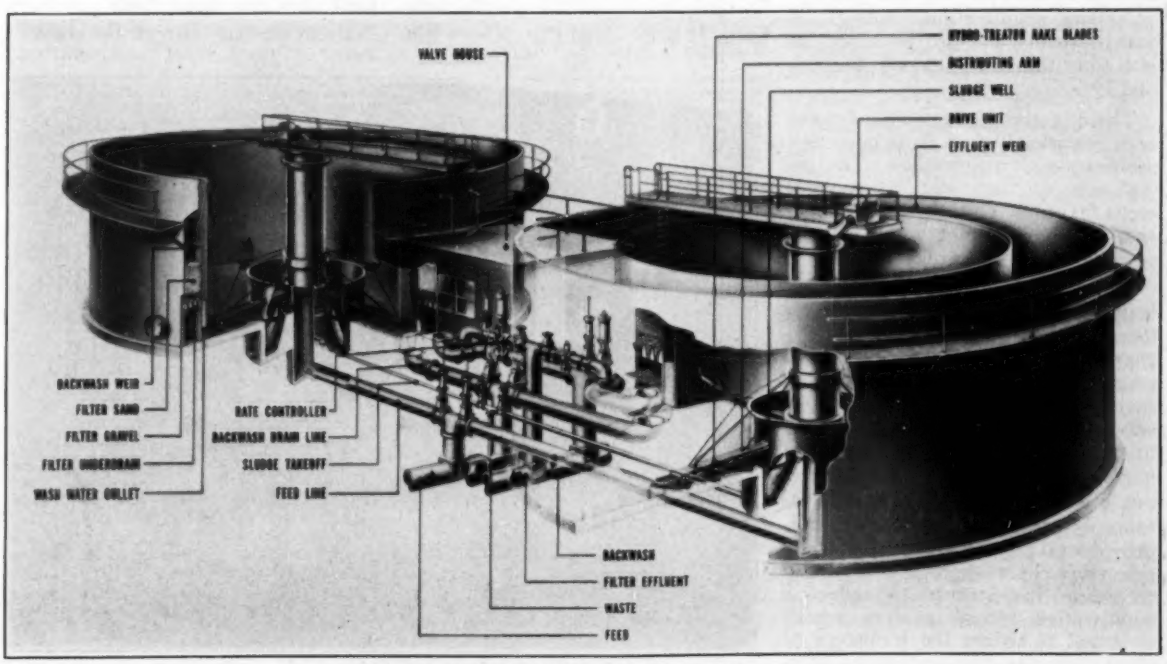
The capacities and unit costs set forth herein are based upon the conventional filter rating of 2 gal. per min. per sq. ft. of filter area; however, all plants are designed to operate at overload ratings varying from 50 per cent to 100 per cent for extended periods of time and most units have been operated satisfactorily at these higher ratings.

Views of the installations at Beaver Run, Westmoreland County, Pa.; Ashtabula, O.; and Chattanooga, Tenn., are also shown.

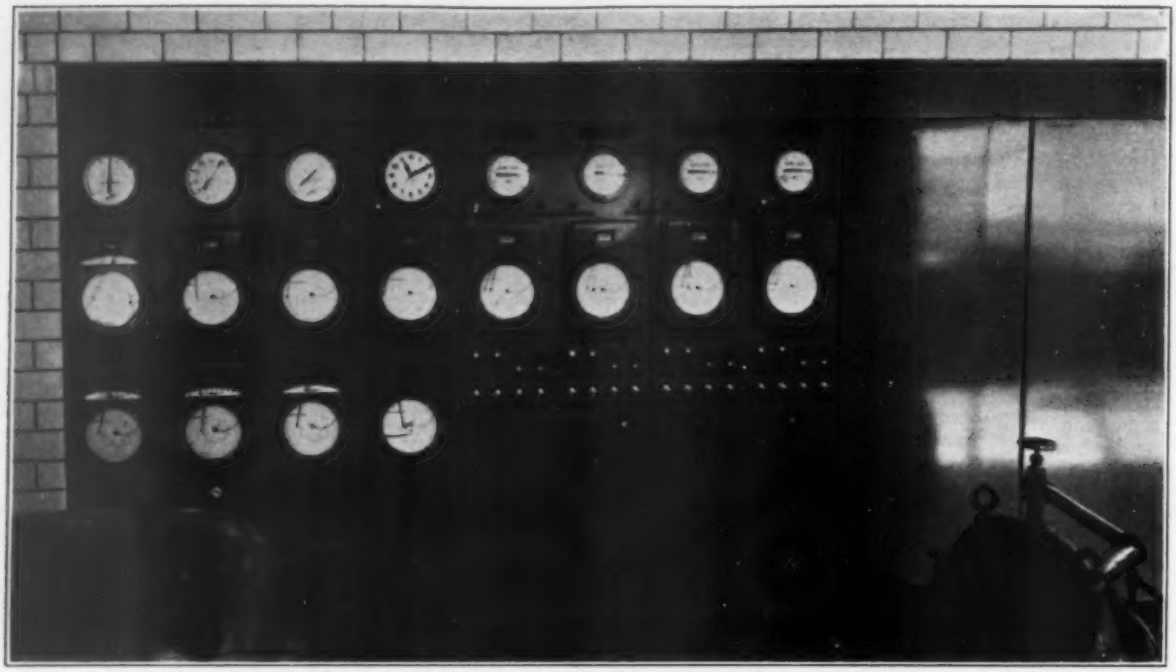
Automatic Filter Control

The plants at Beaver Run, Greenwich, Canonsburg, and a number of those projected for construction, make use of the automatic control of filter washing operations initially developed at the Alexandria plant by Builders-Providence. This operation, now termed "Auto-Central Control," comes into action following a visual and audible warning that a filter has reached a predetermined loss-of-head. The device pushes a button which, through pneumatically operated hydraulic valves and a sequence controller, starts the cycle of valve operations required to wash a filter unit and to return it to its normal filtering operation entirely automatically and without attention by the operator.

In order to control completely the operation of filters from a centrally located control board, the rate of filtration of individual filters can be changed pneumatically from the board. It is possible also to vary the wash rates and the timing of the wash cycle. Washing ordinarily is done in three steps. Initial washing takes place at a rate of about 8 inches ver-



PHANTOM VIEW of the Dorrco Aldrich PeriFilter system.
One of three standard Dorr mechanisms will be employed. The Dorrco Hydro-Treater, illustrated above, will normally be used.



FILTER CONTROL PANEL in the Beaver Run pumping station and control building

tical rise for 1 to 2 minutes to break up the sand bed gently and to produce the maximum abrasive action. The initial wash is followed by washing at a rate of 20 to 24 inches to dispose of the dirty material. Final washing is at a lower rate to result in hydraulic grading of the filter material. Timing and rates of wash applied to a wash water controller also can be varied within limits by the operator by making simple adjustments at the board. Means are provided also at each filter to prolong the washing period if desired.

These automatic operations have been remarkably free from operating problems and maintenance. The initial cost of their installation compares favorably with the conventional operating tables having mechanical or pneumatic and hydraulic controls.

A typical filter control panel board, installed at the Beaver Run Plant, is illustrated. Also illustrated are the four-way hydraulic operating valves controlling the hydraulic valves of two of the filters. These four-way valves can also be operated manually in the valve chamber or at the control panel. On the panel board are numerous other gauges and recorders customarily provided in a plant to indicate operating conditions. Generally seven-day chart recorders are used in recording instruments to reflect a comparative record over a week's time and to reduce the frequency of chart changing and volume of storage.

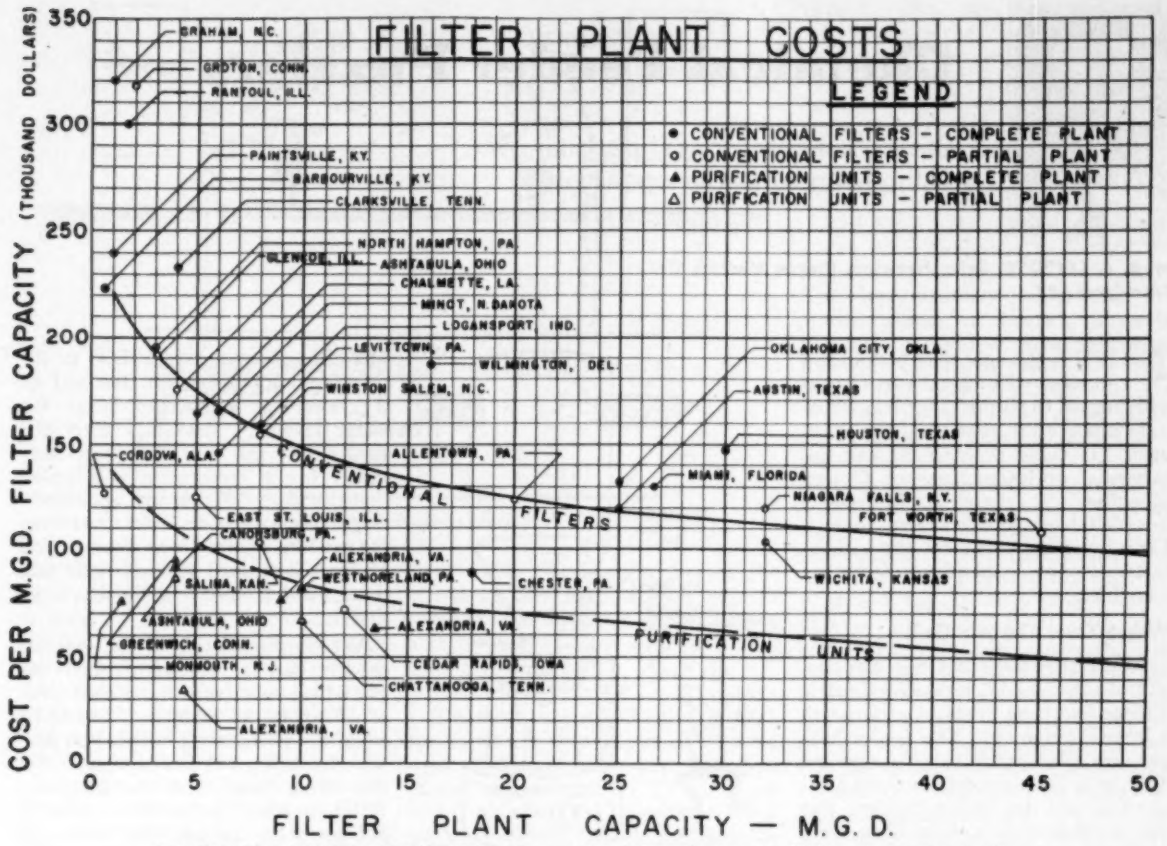
Low Temperature Experience

The use of open filters in conjunction with open settling basins in latitudes and temperature conditions approximating those at the Ashtabula plant, on the shore of Lake Erie, and at Beaver Run, in Westmoreland County, was in some degree experimental. The winter of 1953-54, with some periods of sustained sub-freezing cold, produced no trouble from icing. It is expected that severe winter conditions will produce some icing in these climates, but experience with open settling basins indicates that, without covering the units, these conditions can be handled satisfactorily as far north as the southern part of the Great Lakes region. The savings in heating customarily provided in filter buildings is substantial.

Construction and Operation Cost Data for These Plants

From various sources, the costs of

VALVES AND CONTROLLERS in the Beaver Run Plant
At center left are four-way pneumatically controlled filter valves.



COMPARATIVE CONSTRUCTION COSTS of conventional filter plants and multiple water treatment units

construction of conventional filter plants have been assembled. These are compared with the costs of the treatment units herein described (see Plate I). It is well to recognize that particular conditions apply to most filter plants; these affect the extent and character of construction and of costs. Similarly a 4-mgd capacity plant can not be compared in unit cost with a 50 or 100-mgd plant. Further, a plant having high service pumping station and equipment will cost more per unit than one without such facilities. To compute unit costs, the usual filtration rating of 2 gal. per min. per sq. ft. of filter area was used. This rating applied to all plants using the multiple treatment units and, it is believed, conventional plants as well.

NEW MONMOUTH, N.J., plant, capacity 2 mgd, under construction
Primarily designed for iron removal (tray aerator on left). PeriFilter unit includes mechanical mixing and flocculation. Filtration rate will be 3 gal. per sq. ft. per min.

The operating labor costs of the various multiple treatment unit plants have been low. The Occoquan treatment plant and high service station, having a nominal capacity of 13.5 mgd, has an operating force of 8 men; 4 operators, 2 maintenance men, a chemist and a chief engineer; all except the operators have other duties to perform. A similar force is used at the Westmoreland plant which also operates a low service pumping station by remote control. At both Chattanooga and Ashtabula, no additional operators are employed beyond the force already on duty.

Through mechanization, and by providing some automatic features of operation with adequate safeguards, the minimum possible supervisory and operating forces are required. It is believed that the capital costs of construction for similar sizes of plants cannot be reduced much more and still provide equivalent facilities.

Chemical Feeder Puzzlers

Some "believe-it-or-not" experiences with chemical feeder operation

by **R. J. LEVEQUE**, *Sales Manager, Omega Machine Co. Providence, R.I.*

TRUTH is stranger than fiction, and a number of unusual experiences with regard to chemical feeders seems to emphasize the validity of the statement. If these occurrences had not happened at installations of Omega Machine Co. chemical feeders, I wouldn't have believed them, myself. I can however, vouch for the authenticity of these experiences from my own files.

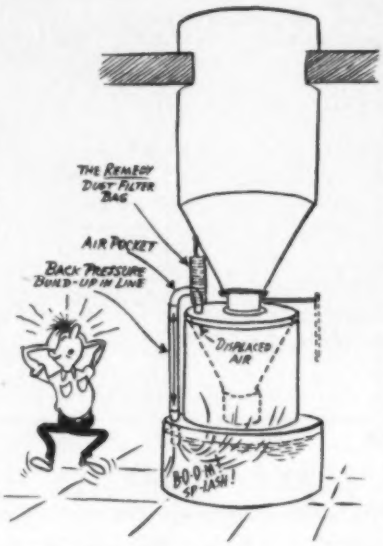
Where Does The Air Go?

In a rather large metropolitan city, a Loss-In-Weight type Gravimetric Feeder had been installed underneath a large storage bin. The feeder hopper was filled periodically by opening a bin gate between the overhead storage bin and the feeder hopper. For this arrangement, a 4-in. diam. vent is placed on top of the feeder hopper so that the displaced air can be exhausted. Our drawings showed a 4-in. duct connected to this sleeve and run up through the floor above into the storage bin. This connection was to be made by the purchaser. The floor above, however, happened to be very thick with considerable reinforcing steel in it.

The utility's maintenance crew, in making the installation, apparently thought there was an easier way to vent the feeder hopper. They installed an elbow on the sleeve and ran the exhaust duct down into the feeder dissolving chamber on the assumption that this would be a good way to get rid of the dust by exhausting it down into the water in the dissolving chamber.

Soon after the installation was made, there seemed to be considerable splashing of water in the dissolving chamber and an unsightly caking of the chemical on the interior of the feeder housing. In this case, a thoroughly competent maintenance crew overlooked the fact that displaced air in the hopper would seek the highest point in which to exhaust itself.

Our serviceman took one look at



DISPLACED air has 'gotta' go somewhere

that elbow and surmised that air collecting at that point was building up a pressure which, when it became great enough, exploded and blew downward with enough force to cause splashing of the water. In order to avoid a long extension of dust duct up through the thick and heavily reinforced floor, the elbow was removed and to the duct was attached a spring-suspended, cloth, filter bag as used in dust collector units. Thereafter when the feeder hopper was filled from the storage bin, the displaced air and dust blew straight upward into the bag. The air filtered out through the bag while the dust was retained and dropped back down into the hopper when the loading procedure was finished.

More Air

Another "air" experience happened in a city in Missouri. The installation was an alum and lime feeder and although our drawing had shown an open T on the discharge line just outside of the dissolver, they had connected a 1½-in. discharge hose directly to the dissolver outlet. There was only about a 4-foot drop to the point of application, but the end of the hose was submerged below the water level. A few days after the feeder was put into operation, they called for a serviceman and stated that the alum solution was apparently clogging up the hose. After watching the machine operate for a short period of time, it seemed quite obvious that there was air binding in the discharge line.

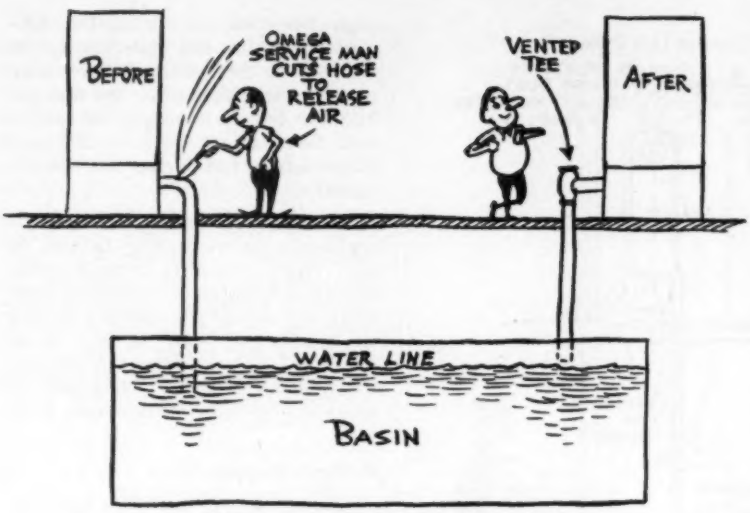
We mentioned this to the superintendent, but he was thoroughly convinced in his own mind that this could not be the problem. He said he could not understand how it was possible for a few bubbles of air to resist the 4-foot head from the dissolver. After assuring him that if our remedy did not solve the problem, we would give him a new piece of hose, he allowed our man to take a pocket knife and make a hole about ¼-in. in diameter in the top of the hose just where it connected to the dissolver. As soon as the hose was punctured, there was a slight gush of air and from then on the solution began to flow readily out of the dissolver.

Wrong Meter

Another experience, in a southern city, involved a Fluoridizer installation which was engineered to operate by proportional control. Specifications called for the flow to be measured through a 14-in. orifice plate, signals to be electrically transmitted through a Chronoflo Transmitter and Chart Recorder. After the installation had been made, the utility complained that there was a marked discrepancy between the readings on the Builders Chronoflo Meter and their existing master meter. The Chronoflo readings followed the master meter readings up to 3 mgd. Beyond that point, the Chronoflo read as much as 1 mgd lower than the master meter.

It is sometimes difficult to diagnose troubles when the patient is 600 miles away from the doctor, therefore, we sent a man to investigate. He found, much to his surprise, that instead of

Ed. Note: This article is based on a talk given by the author before the New England Water Works Assn.



AIR binds solution discharge pipes, too!

installing the orifice plate to measure the flow, they had made a last minute decision to tap onto their existing Venturi tube on their main discharge line from the plant. The maximum range through that 14-in. x 8-in. tube with their master meter was 0.291 to 5.82 mgd, but the design of the proportional control was based on an orifice plate using a Builders Chronoflo with a measuring range of .82 to 8.2 mgd utilizing 240-in. of water differential. The remedy, of course, was to provide the necessary parts to utilize the Venturi meter.

What—No Broom?

These experiences are not entirely without their humorous side: A city in Ohio has several Omega Gravimetric Feeders, one of which is equipped with a rubber-bladed rotor to prevent flooding of the material through the mechanism. A call from the operator said that the rotor mechanism was not operating properly and material was flooding. It was suspected that something had become lodged in the feeding throat and was probably bending the rotor blades, thus breaking the seal and permitting material to flood through. We instructed the operator to remove the rotor mechanism after the hopper was emptied, and to report back the symptoms so that we might advise him what remedy was needed. We were, of course, prepared to send a serviceman if the operator could not solve the problem.

Two days later, a letter from this Superintendent, read in part, as follows:

"I have just made a very interesting observation and have come to the conclusion that your feeders positively will not feed broom handles."

In filling the hopper, one of the operators had used a long pole to level up the material in the hopper and it got away from him.

'Tain't Funny, McGeel

Someone once asked an equipment manufacturer why they couldn't build equipment that was foolproof. The manufacturer replied, "It can't be done; fools are too ingenious." That quip, of course, is not intended to reflect in any way on the integrity or ability of water plant operators.

The following experience happened in a water treatment plant of a large industrial concern. They reported that an Omega belt feeder was not feeding accurately. A service engineer was sent to check the installation. He observed the feeder in operation and the scale beam seemed to be sensitive enough and apparently acting under normal conditions. Gravimetric feeders are so constructed that if for any reason chemical feeding becomes erratic or inaccurate, the scale beam will immediately go out of balance and an alarm bell will ring to warn the operator.

The service man was baffled because apparently nothing seemed to be wrong, but he made a complete checkup before leaving and quite by accident peered up into the feeder. Thus, he discovered that the scale beam had been cleverly tied with a very fine wire which would permit the beam to oscillate, but not enough to go out of balance.

We could only assume that since this ingenuous operator was on the night shift, the ringing of the alarm bell disturbed his sleep and that he resented having to get up in the night to remedy the trouble or to fill the hopper. They say that lazy people always make the best inventors and you can take it from me that this fellow really did a job on that scale beam. His work was a masterpiece of concealment.—P.S. "Willie doesn't work there any more."

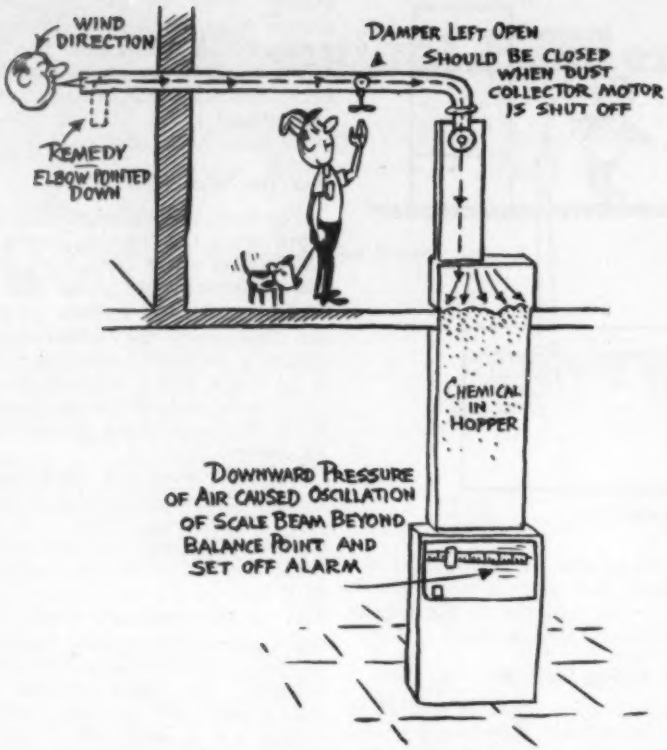
And The Wind Blew

The most baffling experience happened on a Gravimetric Feeder installation in upper New York State. The superintendent wrote that the feeder would not operate properly and that the sentinel alarm rang continuously no matter what they tried to do in the way of adjustment. He said the ringing of the alarm could not be stopped without shutting down the feeder.

A service man was dispatched to perform the usual close checks, but he could find nothing wrong. The hopper was filled with material and the feeder started. It ran continually until it had fed all but a pound and a half of the chemical. During this entire period, the machine functioned normally and the scale beam stayed in balance. The Superintendent was exasperated. He guessed that the trouble was probably due to the fact that his six operators had six different versions of how this feeder should be run, and apparently got so mixed up with their own method of trying to run it that not one of them could run it correctly for any length of time. After this demonstration, he was satisfied that there was nothing wrong with the feeder.

Two days later a telephone call from a very indignant superintendent said to "get up here at once or else." When the serviceman arrived, the

"OUR FEEDERS positively will not feed broom handles"


WIND DIRECTION
DAMPER LEFT OPEN
SHOULD BE CLOSED WHEN DUST COLLECTOR MOTOR IS SHUT OFF
REMEDY
ELBOW POINTED DOWN
CHEMICAL IN HOPPER
DOWNWARD PRESSURE OF AIR CAUSED OSCILLATION OF SCALE BEAM BEYOND BALANCE POINT AND SET OFF ALARM

THE WIND blew, and the bell rang!

feeder was operating normally again. More perplexed than ever he decided to take a walk around the plant to do a little deep thinking. His walk took him upstairs to the chemical storage room and being naturally curious, he inspected the discharge duct which extended from the dust collector unit to the outside of the building. This line was equipped with a damper and our serviceman started fiddling with this damper to see if it was working freely. He left the damper open for about a minute, and, lo and behold, the alarm bells on the feeder downstairs started ringing like mad.

"No, this just can't be," he said to himself, but there it was. Outside, rather strong wind was blowing in the direction of the dust duct. The velocity of the wind blowing back through the dust duct was great enough to upset the balance of the delicate scale mechanism, causing the alarm to sound. Then the superintendent and operators recalled that on the days when the feeder gave trouble, the wind was blowing sharply. As a check the damper on the exhaust duct was closed, the feeder scale beam went into balance and the alarm bell stopped ringing. By way of a permanent remedy, the damper was removed from the exhaust duct and an elbow pointing downward installed outside the building.

Tattle Tale

An Illinois plant Superintendent reported that chart recorders on the chemical feeders presented damaging evidence against an operator who was not handling his job properly. It seems that this operator was scheduled to fill the feeder hopper every morning at 7 o'clock. He would lock the scale beam on the Loss-In-Weight Gravimetric Feeder, to keep it steady while filling. After moving the balance poise out to the end of the 500-pound capacity scale beam, he would go upstairs and fill the hopper.

The operator knew that the Superintendent was not in the habit of arriving at the plant until about 8 o'clock, so at about ten minutes to eight, the operator would come downstairs, unlock the scale beam, and balance out the poise on the scale beam. The scale beam capacity was 500 pounds, but apparently the operator had dumped only about 440 pounds in the hopper. Since the rate of feed was set to deliver 37.5 pounds per hour, 30 pounds were delivered in this 50 minute period, leaving 410 pounds in the hopper. So at 7:50 A.M. when the operator came downstairs and balanced the scale beam, the poise was moved back to 410 pounds. Since the poise had previously been moved out to the 500-pound mark on the scale beam, this showed on the recorded chart supposedly as the amount he had dumped into the hopper to begin the shift's run. Substracting 410 from 500 gave 90 pounds as fed during this 50-min. period.

Since moving of the counterpoise registers a corresponding distance on the chart recorder, representing pounds fed, the error showed up glaringly and forced the operator to give an account of what he was doing between 7 o'clock in the morning and ten minutes to eight. All denials of misdeeds by that operator were to no avail.

It Can't Happen Here

During World War II a hurry-up call came from an Ordnance Plant in Iowa. Omega feeders and slakers were being used to feed quicklime to soften the extremely hard water found in the gravel beds of Central Iowa. Every day or two, the lime slaker clogged up because of carbonate plating out on the sides of the slaker and on the impeller. The high-speed impellers turning at about 800 rpm were so caked up with material that they looked like large coconuts. The 1-3/16-in. diameter tapered shafts on the mixers looked like baseball bats. Such an occurrence was simply unheard of.

The first check was to ascertain if the water temperature was high enough to insure efficient and complete slaking. It was — — — so it was assumed they were using a water-to-lime ratio of 4 or 5 to 1 in order to obtain the high operating temperatures. This was not the case. They had a large supply of warm water available from a heat exchanger and all of this water was being diverted into the slaker. Instead of a 4 to 1 water-to-lime ratio, they were using a ratio of about 14 to 1, and softening was taking place in the slaker, and the velocities caused by the high-speed mixers, calcium carbonate was plating out. The remedy was to reduce the water supply to the slaker to about a 6 to 1 water-to-chemical ratio.

Reverse Safety

At another plant, the operators were afraid to operate the slaker at high temperatures, although high temperature slaking is proper and more economical. The temperatures never should be permitted to fall below 160°F. To prove that there is no danger in operating slakers at this temperature, servicemen start up slakers, at temperatures up to 190° and 200° F.

Nevertheless, in this plant, although the day shift operated slakers at 150° to 160°F., the night shift, wanting to play safe, opened up the water valve and let the temperatures drop to 100° to 110°F. Operating at these extremely low temperatures resulted in considerable unslaked lime leaving the slaker. On one occasion, this unslaked lime gradually built up in a 6-in. discharge line so that finally the discharge line, (built large to avoid stoppage) completely filled up and the slaker started to overflow. The operator, noting the difficulty, picked up a piece of reinforcing bar, which had previously been used to rod out the discharge line whenever it showed signs of plugging up. This time, however, the moment he tapped the plug in the discharge line, it blew up in his face and caused severe burns.

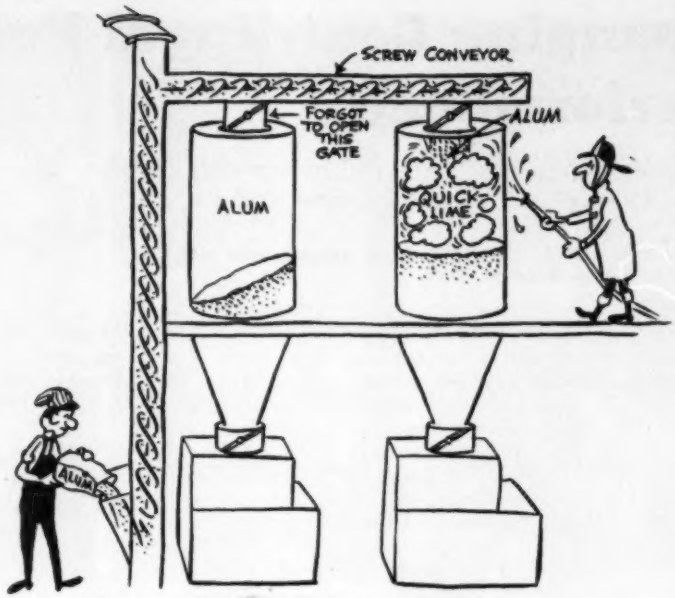
What happened? — — Large particles of unslaked lime had settled in the discharge pipe, continued to slake and as they slaked, more heat was evolved so that neighboring particles of lime which only needed heat to make them slake properly, also started to slake. When all the available water in the pipe was used up, steam began to form and the operator happened along just at a time when the pressure built up in that pipe was extremely great. The moment he made a hole in the plug of lime, the steam rushed upward like a geyser.

Some Things Don't Mix

At one installation, chemicals are hauled from a freight siding some distance away by truck into the plant and an inclined screw conveyor is used to elevate quicklime and ferrous sulphate (copperas) into overhead storage bins. The same screw was used for both chemicals and proper gates opened to allow the right chemical to go into the right bin. A small leak developed at one of the connections to the screw so that a thin stream of chemical sifted down onto a boardwalk below the conveyor during the loading operation.

In one instance, both copperas and quicklime were loaded the same day. Sometime near the end of the filling operation, it was noted that the boards below the conveyor were burning merrily.

What had happened? — — — The lime had absorbed some of the water of crystallization in the copperas causing it to slake. As it slaked, the temperature rose, increasing the speed of the reaction. Soon, the small mass of mixed quicklime and ferrous sulphate reached combustion temperature and the boards broke into flames.



QUICK, Henry, the fire department!
P.S.—Don't mix chemicals in storage bins.

There have been similar instances of fires or charring of filter bags in vacuum type unloading systems where the same system is used for ferrous sulphate and quicklime.

In another instance, the same conveyor system was used to elevate alum and quicklime to steel storage bins. The alum bin and the quicklime bin were adjacent and the operator manipulated valves in order to direct the chemicals into the proper bin. With such installations, it is inevitable that mistakes are bound to occur and in this case, our engineers warned what might happen. In the interests of economy, however, a single elevator was installed.

The inevitable happened when, within a few months, alum was dumped into the quicklime bin. The bin began to heat up, paint began to smoke and peel off of the steel bin and the fire department was called. They very wisely decided against putting water into the bin which could very well have caused the quicklime to explode. Presumably the firemen played water on the outside of the bin to keep the temperature down as much as possible to prevent the bin and steel supporting members from buckling, but the final "melt" had to be dug out of the bin by men with picks and axes.

Wrong Way Corrigan

In a large industrial waste treatment plant in Michigan, the equipment was installed by the contractor and merely had to be checked and given a final inspection by the servicemen of the various equipment manufacturers. The plant superintendent confidently set a date for starting up with the hope that all they would have to do would be to go around and push buttons and the plant would start to function. There were several chemical feeders and a couple of lime slakers so that probably a dozen motors were involved insofar as Omega equipment was concerned. Our serviceman arrived early in the morning and when he started up the machines, he found four motors running backwards. This represented one third of the motors on the Omega equipment turning in the wrong direction. This seemed a rather high percentage and after reversing the leads on these four motors to make them run properly, he called the Superintendent's attention to the fact. Together they found a centrifugal pump and a exhaust fan also running backward.

The Superintendent decided to postpone starting the plant for another day so that he could make a complete inspection of all motors. "Believe it or not," in this plant they found a total of 29 motors turning in the wrong direction.

If these incidents have any moral, I believe it is that servicemen sent out by equipment manufacturers can be most helpful, not only because of their familiarity with the specific equipment involved of their own manufacture, but because of their background, general knowledge and experience gained from the sort of situations outlined in this paper.

Changing Centrifugal Pump Performance

Characteristics can be altered by varying speed or by modifying the impeller diameter

by **JACK A. CABLE**, *Application Engr., Allis-Chalmers Mfg. Co. Norwood Works, Norwood, Ohio*

THERE are many occasions where it becomes necessary to make a change in the performance characteristics of existing centrifugal pumps. A definite set of formulas apply to specific changes which can be accomplished either by running at a new speed or by modifying the impeller diameter at the existing speed.

These basic formulas primarily concern speed change. They are:

1. $\frac{\text{Speed a}}{\text{Speed b}} = \frac{\text{Quantity a}}{\text{Quantity b}}$
2. $\left[\frac{\text{Speed a}}{\text{Speed b}}\right]^2 = \frac{\text{Head a}}{\text{Head b}}$
3. $\left[\frac{\text{Speed a}}{\text{Speed b}}\right]^3 = \frac{\text{Brake Horsepower a}}{\text{Brake Horsepower b}}$

Approximately correct results will be obtained by substituting:

$$\frac{\text{Diameter a}}{\text{Diameter b}} \text{ for } \frac{\text{Speed a}}{\text{Speed b}}$$

in any of the above 3 formulas.

There are, of course, some limiting factors such as the size and shape of water passages which can effect these ratios; but, generally speaking, this set of formulas will closely predict what change will take place.

Comparative Curves

Let us compare curves for the same pump operating at 1750 RPM, in Fig. 1, and 3500 RPM, in Fig. 2. Take the best point of efficiency at 200 GPM and 27 ft. (Point No. 1) on the 1750 RPM curve, Fig. 1, and apply our formula:

$\frac{1750}{3500}$ should equal $\frac{200 \text{ GPM}}{400 \text{ GPM}}$

and at the same time $\left[\frac{1750}{3500}\right]^2$

should give us a head point on the curve in Fig. 2.

Then $\left[\frac{1750}{3500}\right]^2 = \frac{27}{X}$ or $\frac{1}{4} = \frac{27}{X}$

and $X = 4 \times 27 = 108$

Which is the new head on the 3500 RPM curve in Fig. 2 (Point No. 2). So, our set of head and capacity formulas is found to hold. The efficiency changed slightly, which is probably due to the higher velocity at the higher speed.

Using the Slide Rule

At this point, we will explain an easy way to use a slide rule to figure what will happen. Fig. 3A is a photo of a slide rule with the 1750 vs. 3500 speed ratio set up on the "C" & "D" scales respectively. The pump capacity ratio, also being direct, is located by setting 200 on the "C" scale and getting 400 on the "D" scale. (Fig. 3B). That part is easy, but now notice that taking 27 (the ft. hd. at 1750) on the "B" scale, one finds the corresponding 3500 RPM head of 108 ft. on the "A" scale (Fig. 3C). This use of the slide rule thus gives both the direct ratio on the "C" and "D" scales and the squared speed ratio on "B" and "A" scales.

Generally speaking, within reasonable limits a similar set of formulas can be set up using impeller diameters instead of speeds. However, by changing impeller diameter one also alters the outlet angle (the angle at which the water leaves the impeller), so this formula usually will not hold for any change in diameter more than about ½ in. For example, examine Fig. 1 and the 5½ in. and 5 in. curves. Take the 200 GPM vs. 27 ft. head set of conditions (Point No. 1) on the 5½ in. curve, and step this down to see what results should be obtained with a 5 in. impeller.

Again using a slide rule, set up the 5 in. to 5½ in. ratio on "C" and "D" scales respectively (Fig. 4A).

$$\text{Then: } \frac{5''}{5\frac{1}{2}''} = \frac{Qa \text{ (GPM at 5")}}{Qb \text{ (GPM at 5½")}}$$

Thus, on "C" and "D" scales, 200 GPM reduces to 182 GPM (Fig. 4B). At the same time, by formula:

$$\left[\frac{5''}{5\frac{1}{2}''}\right]^2 = \frac{Ha \text{ (Head at 5")}}{Hb \text{ (Head at 5½")}}$$

Then, on "B" and "A" scales, 27

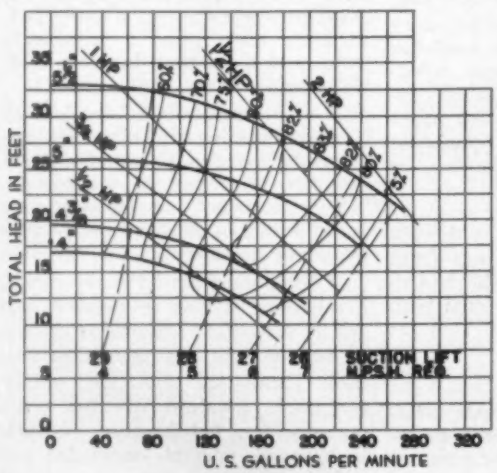


Fig. 1—at 1750 rpm

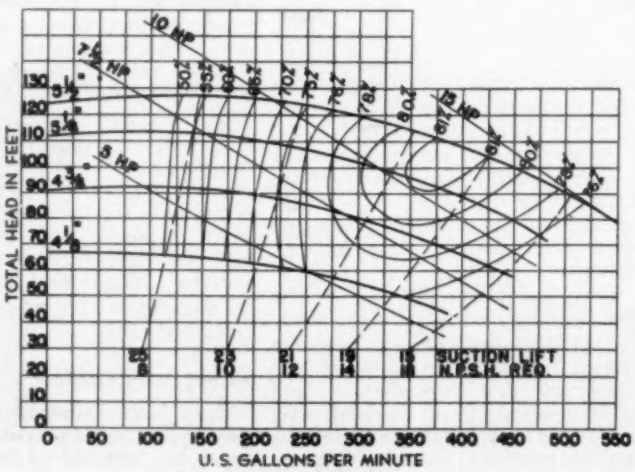
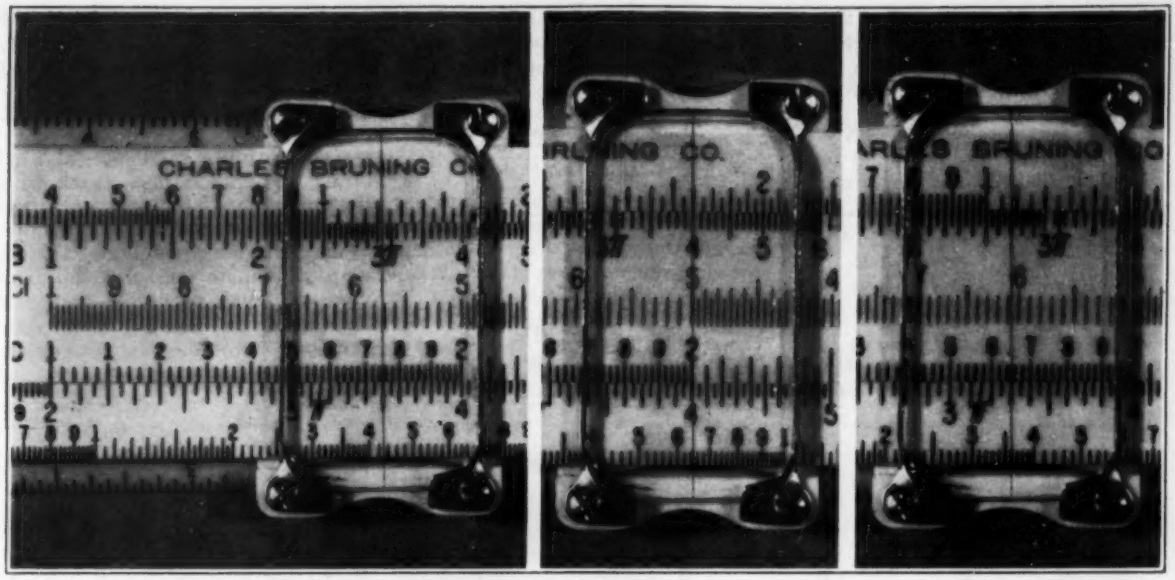


Fig. 2—at 3500 rpm

OAK TREE CURVES for one centrifugal pump operated at rpm specified in text



Figs. 3A, 3B, and 3C—SLIDE RULE will show direct ratio (C and D scales) and squared speed ratio (B and A scales).

ft. reduces to 22 ft. (Fig. 4C), which result agrees rather well with the 5 in. curve in Fig. 1 (Point No. 3).

Typical Problems

Having reviewed the theoretical set up, let us take a typical problem using these two curves and see how to apply the rules.

As an example:

Existing pump is rated at 210 GPM at 20 ft. with 5" impeller (Point No. 4).

Then, the rating desired is 210 GPM at 89 ft.

We can easily see from Fig. 1 that this rating cannot be obtained without increasing the pump speed. (Here we have curves for both speeds but the pump manufacturer should be consulted for curves for any pump before it is rerated, in order to be sure that increasing the speed or changing impeller diameters is practical.)

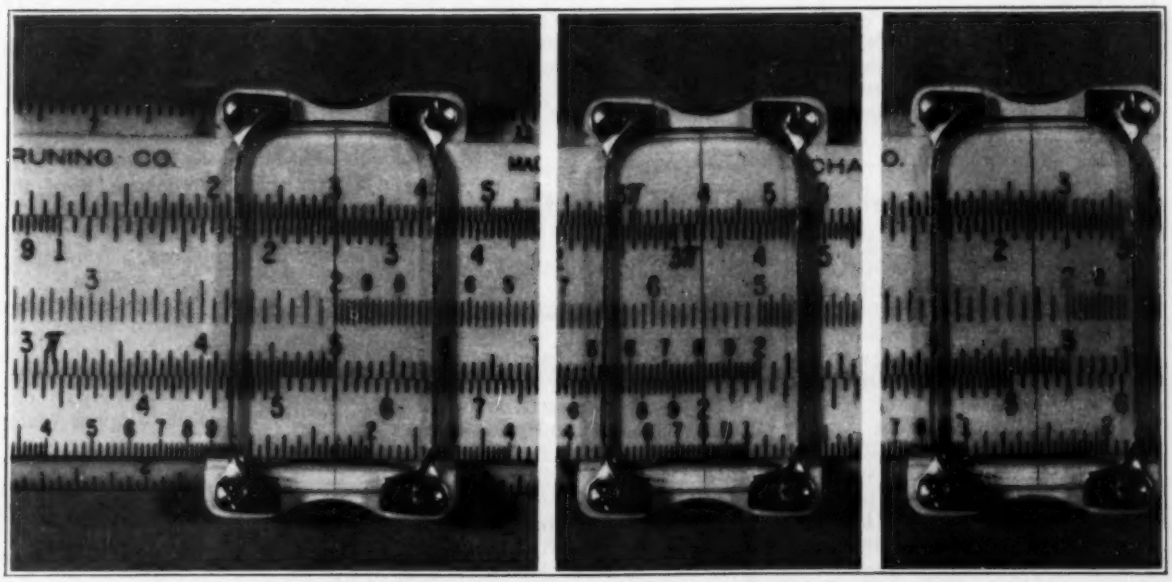
Direct Motor Drive

First, we would see what results are obtained by increasing speed to 3500, assuming that a direct motor drive was to be used:

$$\frac{\text{Speed a}}{\text{Speed b}} = \frac{1750}{3500} = \frac{1}{2}$$

Therefore, for any given point on the 1750 curve, the capacity will vary by a 1 to 2 ratio, and the head by $(1/2)^2$ or 1 to 4 ratio. Pumps operate somewhere on a curve, not at just one point, so for checking for the new rating, disregard the exact point of the old rating and proceed as follows:

Since we want 210 GPM at 3500 RPM, we start from 105 GPM at 1750 RPM and check our known 5 in. curve (Fig. 1) for the present head at this capacity which is 25 ft. (Point No. 5). If we then double the speed, the new head would be $25 \times 4 = 100$ ft. (Point No. 6) when the 5 in. impeller runs at 3500 RPM. This gives us more head than de-



Figs. 4A, 4B, and 4C—SLIDE RULE illustrates results obtained by changing impeller diameter from 5½ in. to 5 in.

sired, so it will be necessary also to reduce the impeller diameter to about 4¾ in. as shown in the Fig. 2 curve. Here the answer is provided by the 3500 curve in Fig. 2 (Point No. 7), but even without this complete oak tree curve, we could verify the new diameter by the formulas:

$$\frac{5''}{4\frac{3}{4}''} = \frac{220\ \text{GPM}}{210\ \text{GPM}}$$

$$\left[\frac{5''}{4\frac{3}{4}''}\right]^2 = \frac{99\ \text{Ft. Head}}{89\ \text{Ft. Head}}$$

Turbine Drive

To point out one other possibility, let us assume the pump unit to be turbine driven so that there is a choice of new speeds. We would then need to compare on this basis:

$$\frac{\text{Speed a}}{\text{Speed b}} = \frac{1750}{X} = \frac{Qa}{210\ \text{GPM}}$$

$$\left[\frac{\text{Speed a}}{\text{Speed b}}\right]^2 = \frac{Ha}{89\ \text{Ft. Head}}$$

We start by estimating the new speed, and then alter estimates until we get the ratios to agree. Again, the slide rule comes in handy. It can be seen from the two curves that the new speed should be less than 3500, if we have this choice, so let us try 3400 RPM. Set 3400 on the "C" scale, opposite 1750 on the "D" scale. Then, the Qa would be 108 GPM. At this point the head is about 25 ft., which would equal about 94 ft., so 3400 is a bit too fast. Vary this a bit and you may settle for 3300 GPM, or maybe about 3325 RPM.

CAUTION: For any appreciable increase in pump ratings, check with the pump manufacturer before making changes, so that the manufacturer may determine pump design limits as to maximum pressures, etc. Decreasing pump output by reducing impeller diameter is limited only by the minimum usable diameter impeller, so only this factor need be checked.

British Sanitarian in U.S., En Route to New Zealand

Dr. Harold Wilson, Ph.D., (center) Fellow of the Royal Institute of Chemistry, is shown in the above photograph as he was welcomed to Wilson & Co., in Chicago by Vice-President C. W. Becker (right) and A. J. Steffen (left). Dr. Wilson, who is President of the Royal Institute of Sewage Purification, is en route from England to Auckland, New Zealand, where he will serve on a special commission to advise the Auckland Metropolitan Drainage Board.

During his two-day visit at Wilson's General Offices, Dr. Wilson spent considerable time with Steffen, Wilson's Sanitary Engineer, learning about the latest American methods for the treatment of packing plant wastes.

Continuing Studies of Algae to Treat Radioactive Waste

For two years Prof E. W. Steel and his associates in the Sanitary Engineering Research Laboratory at the Balcones Research Center of the University of Texas at Austin have been studying the value of algae in the treatment and disposal of liquid radioactive wastes, and the removal of the algae from the liquid.

It is known that algae will take up radioactivity from water. After this transfer, however, it will be necessary to remove the algae from the water. The purpose of this project is to develop means of propagation of algae under conditions simulating actual waste-disposal conditions, and methods of removing and disposing of the algae.

Methods of growing algae in small containers have now been developed. Three ponds have been constructed for algae growth on a larger scale. The uptake of radioactivity by algae with several different radioisotopes and also with mixed-fission products has been determined. Studies are continuing on the concentration of algae by chemical precipitation and by vacuum filtration. The project is sponsored by the Atomic Energy Commission.

Fuhrman Submits Plan For Potomac River Clean-Up

Ralph E. Fuhrman, in a report submitted recently at a public meeting of the Interstate Commission on the Potomac River, outlined a four-point program to combat pollution of the river. Representatives from Maryland, Virginia, West Virginia, and Washington, D.C., attended the meeting.

The report was based on a survey of the north branch of the Potomac between Paw Paw, West Va., and Luke, Md. The Commission retained Fuhrman, who is Deputy Dir. of Sanitary Engr., D. C. Sanitary District, to make the survey and report; U.S.P.H.S. funds were used to finance the project.

Fuhrman stated that in the summer the water around the Cumberland Dam became 100 per cent polluted, to the point where it contained no oxygen to support living organisms.

Fuhrman outlined these four steps to clean up the river:

1. Reduce waste at the Luke mill by 64 per cent.
2. Eliminate fly ash and reduce waste at the Celanese plant by 70 per cent.
3. Install a sewage-disposal plant at Cumberland to take care of the city's suburbs.
4. Continue to assemble water quality data to keep a continuing check on the river's condition.

Other speakers at the meeting were George Hall, Maryland Health Department engineer; Dr. John Geyer, professor of Sanitary Engineering at Johns Hopkins University; John Lester, of the West Virginia Water Commission.

The Welcome Salesman

The most welcome salesman is he who peddles good cheer.

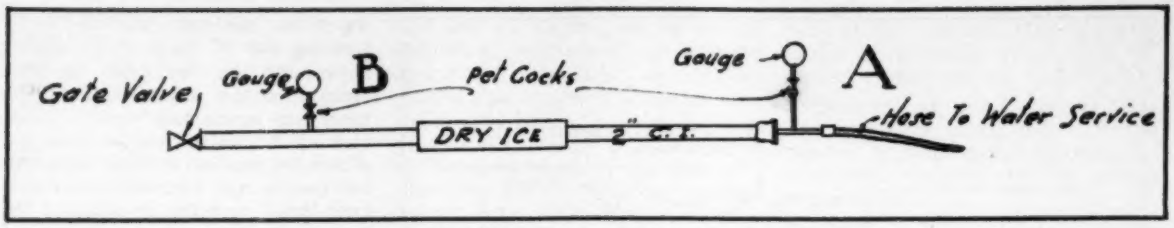


Fig. 1—EXPERIMENTAL set-up of main freezing demonstration

Freezing Cast Iron Mains As Shut-off Measure

Two, four and six inch mains successfully frozen. Next on the schedule, a twelve inch main.

by W. S. MAUS, Engineer, Water Works Div., Public Service Dept., City of Burbank, California

THERE are few water works operators who have not been confronted with the problem of making emergency repairs to some of their mains without shutting off some consumers, or laying temporary lines to take care of the situation. Our problem was that of laying a new main to connect to an existing one and there was no valve available to shut off the existing line.

Perhaps some of the readers of the Reference & Data Edition of this magazine have frozen service connections, of ¾" and 1" size, by the use of either wet or dry ice.* The dry ice is much more convenient today, and is in most cases available without much difficulty. However, the freezing of mains of cast iron pipe may seem to be too large and risky a problem to undertake. The first question was the danger of breaking or cracking cast iron pipe; then the time required, the material, etc. It is true, that experiments were first made on 2", 4", 6", and then a 12" cast iron pipe in the shop yard and the proper procedure developed.

* Ed. Note: The author is referring to the article by John L. Ford, "Quick Freezing of Small Pipes for Repairs," on page R-76 of the 1952 issue of the Reference and Data Edition of *Water and Sewage Works*.

This useful article has also been reprinted on page 133 of the 1954 Reference and Data Edition by popular demand.

Experimentation

With the freezing of pipe experimentally when the pieces are eight to sixteen feet long, the matter of pressure is a consideration. As the ice freezes it must expand, and since the pipe length is limited the pressure will be built up perhaps to 200 pounds or more. To release this, a pressure gauge was put in the pipe length, on each side of the freezing unit. Below the gauge a pet cock was inserted with which to relieve the pressure, should it reach a questionable point. (See Fig. 1)

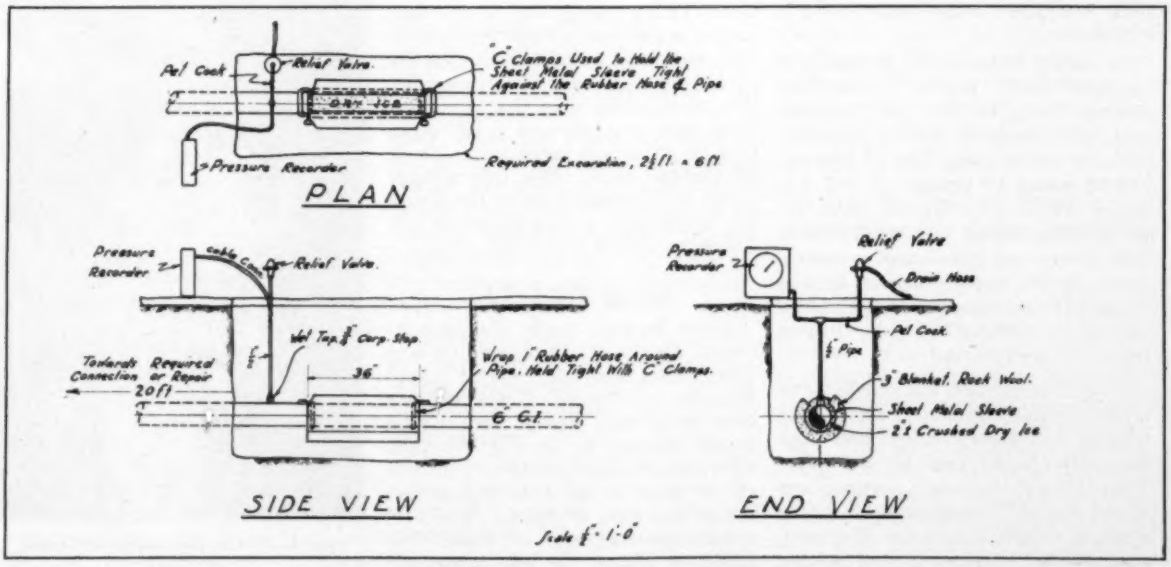


Fig. 2—FIELD SET-UP of actual freezing of 4" and 6" mains

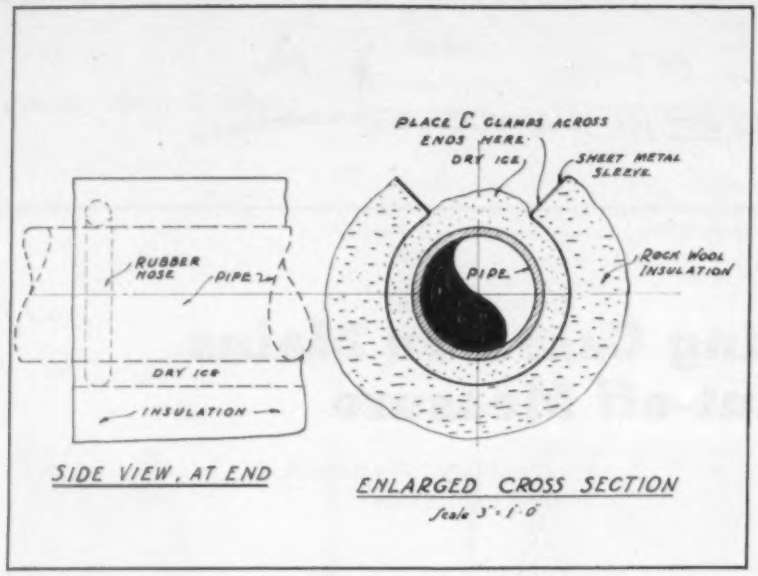


Fig. 3—DETAIL sketch showing dry-ice pack, sleeve-trough, insulation, and rubber hose gaskets

At the "A" end, a ¾" hose was connected to the water service or supply, which in this case had 100 psi pressure. At the "B" end a gate valve was attached and held securely in place. As the freezing process was in progress, both gauges were observed. The freezing increased the pressure at both gauges. When the gauge at "B" did not register further increase in pressure, it was an indication that the ice plug was completely formed. The valve at "B" was carefully "cracked" to bleed out the water in the pipe between the ice plug and the valve, then opened fully to make sure the pipe was actually completely frozen and that the ice plug would hold against the 100 psi pressure.

A similar procedure was followed on the 4" and 6" pipes. The only difference being in the time required and the amount of dry ice required to form the ice plug. The 2" pipe required about 40 pounds of dry ice, which was not broken up; and, no ice melting liquid was used. About four hours of time was required. Later in the experimenting, it was requested that the dry ice be crushed and that a melting liquid be used to expedite the freezing.

When the dry ice was crushed and melting liquid (gasoline) added, the 6" pipe was frozen in less time than formerly was required for a 2" pipe. There was nothing outstanding about the 4" experiment, it being along the same line as the 2" experiment, ice not crushed, and no melting liquid was used.

We Tackle a 12" Pipe

On the 12" pipe, more equipment was brought into use, it being desired to learn more about what went on in the inside of the pipe during the process of freezing. A potentiometer was brought into use. The potentiometer is an instrument used to register temperature on the inside of a pipe or any vessel. Registration points were set up at different positions in the pipe, namely, next to the outside of the pipe, an inch or more towards the center of the pipe, then three or four inches in, and a point at about the center of the pipe. Temperatures lower than 100 degrees minus were recorded on this experiment. This being a very large pipe, almost seven hours were required to form the plug, and about 350 pounds of dry ice was used. The reason for this experiment was that the city must raise a portion of a 12" main to give way for a large storm drain installation at a busy intersection. What we learn from doing the actual job in the field will be reported in a follow-up article in this magazine.

Actual Field Jobs

After having made the experiments, the proof of the pudding was doing it in the field, under actual working conditions. A new 6" cast iron main was being laid, which would connect to an old 4" main. However, it was desired to continue the 6" main across this intersection which had two 4" mains. The first connection had one 4" valve that could be closed. On the other side of the cross there was no valve. So we tried out our experiment by freezing the 4" main. A couple of days later, the city made the connection to the other 4" main. As there was again only one 4" valve, and no 6" valve on the main to which we wished to make the connection, it was necessary to freeze *both* the 4" and the 6" mains at the same time. The operation was just as successful as, and somewhat more simple than, the experimental freezing in the yard. The accompanying drawings show details of this set-up.

The excavation was about six feet long and about two and a half feet wide. The freezing chamber consists of a sleeve trough of sheet metal, around which was wrapped a blanket of rock wool insulation about three inches thick. At each end of the three foot long sleeve, a piece of rubber hose was used around the pipe, to keep the crushed dry ice and melting liquid from leaking out. Metalshop C-clamps were used to hold the sleeve together at the top. A corporation stop was placed in the line beyond the freezing zone. As a safety precaution, a 100 pound pressure relief valve was used, so as to "kick off" if the pressure got beyond that point. Because of the length of the main, the increased pressure due to the freezing plug was negligible, and the safety relief valve was actually not needed.

Freezing Time

The 4" main was frozen in about one and a quarter hours, and the 6"

Fig. 4—DITCH photograph of freezing of 6" main
Note one of the C-clamps near the pipe-bell

main was frozen in about two hours. About 150 pounds of dry ice was used for the dual job. One could figure on about five quarts of gasoline for the 4" and say seven quarts for the 6" main. The men in the field doing the work were enthusiastic in their praise of the operation. No one was out of water, no temporary services had to be run, no one was dissatisfied.

A Few Suggestions

I might suggest that the ends of the sleeve that goes around the pipe and holds the dry ice, be as tight as possible to prevent the dry ice and the melting liquid from leaking out. A rubber hose or other wrapping material, may be used and the sleeve clamped tightly around same. Also that use of alcohol, or an alcohol substitute, will speed the freezing operation. "Lacohol", a product of the Los Angeles Chemical Co., which sells for 36c a quart, has been used locally. Also, it is not advisable to throw warm water (or even cold water) on the ice "plug" to expedite the thawing, as is sometimes done where small service pipes are frozen. This could easily break or crack the cast iron main. One can get a fairly good approximation of the amount of dry ice required by the comparative circumferences of the pipes. A good estimate of the amount of alcohol (or substitute) would be one gallon to 50 pounds of dry ice. For the most part we have used gasoline because of its lower cost in comparison with alcohol. For increased speed of freezing some form of alcohol is markedly to be preferred.

Although no exact figures were kept as to the amounts of dry ice required in each operation, some approximate amounts can be given, as follows:

Pipe Size	*Lbs. Dry-Ice*
2"	35 lbs.
4"	60 "
6"	100 "
8"	175 "
10"	250 "
12"	350 "

As earlier stated the quantity of alcohol or alcohol substitute required is about one gallon for each 50 pounds of dry ice used. Gasoline may be used as the alcohol substitute but is slower in its effects.

George Mebus Recipient of Award for Distinguished Service

George B. Mebus, consulting municipal and sanitary engineer of Glenside, Pa., has been cited for "distinguished and outstanding service in the field of municipal engineering and public works administration" by the Philadelphia Chapter of the American Public Works Association. With the citation goes "The Meritorious Service Award," consisting of a gold medal pendant to a ribbon of blue and gold. The award was made at the annual dinner of the Philadelphia Chapter of A.P.W.A., of which the recipient is a past-president.

Mr. Mebus, with 28 years of service in municipal engineering, succeeded his late father, Chas. F. Mebus, in 1940 and is now president of George B. Mebus, Inc. A graduate of Pa. State University in 1925 and winner of the degree of Civil Engineer in 1949. During World War II he served overseas in the Corps of Engineers, winning the rank of Lieutenant Colonel and four service medals.

At present Mr. Mebus is serving a number of Pennsylvania towns and boroughs as engineer and as consulting engineer to a number of other townships and boroughs. On his staff are forty-seven full time employes.

Milwaukee Loses Ruling on Water Service

Must supply water to building only one-half within city

A Circuit Judge has upheld a state public service commission decision ordering the city of Milwaukee to supply complete water service to a General Motors Corp. building at 4066 N. Port Washington Rd.

The office building and warehouse is about half in the city of Milwaukee and half in the city of Glendale. Milwaukee for some years has provided water to the half within its borders, but has refused to service the other part.

Judge Sachtjen ruled that a city must provide water for a business place or home even though part of the building is outside the city limits.

Plan Pollution Control of Missouri River

The state health department has asked Kansas City to proceed at an early date with plans for financing and constructing a disposal plant for sewage, garbage, and industrial waste, to lessen pollution of the water in the lower Missouri river. This is the first definite move toward compelling the city to abate its part in stream pollution.

Notification came from L. E. Ordelheide, director of the bureau of public health engineering for the State health department, who said the same requests are being made to all cities and industries along the Missouri. Kansas City now discharges untreated sewage and industrial wastes into the Missouri, and into two tributaries, the Kaw and the Blue rivers.

C. R. Cox retires from N.Y. State Health Dept.

Accepts position in Brazil with U. S. Govt.

The New York State Dept. of Health in Albany has announced the retirement of C. R. Cox, who, for many years, has been Chief of the Water Supply Section of the Bureau of Environmental Sanitation.

Mr. Cox plans to continue his work in the sanitation field. He has accepted a position as Sanitary Engineer with the U. S. Operations Mission in Rio de Janeiro, Brazil, and will act as technical adviser for the Mission on a program for improving water supply and sewerage facilities in Brazil.

Marion, Ill., Sewage Plant Recognized for Good Operation

At a recent meeting of Illinois sewage treatment plant operators held in Springfield, a special trophy award was presented to the Marion, Illinois, Sewage Treatment Works for "best maintained and operated" plant of its kind in Southern Illinois. Our congratulations to Clarence Stokes, Sanitary Engineer in charge of the Marion works. Credit should go also to John Ward, Engineer on the project representing Consoer, Townsend and Associates, Consulting Engineers of Chicago who executed the Marion project.

CLEVELAND'S intake crib in Lake Erie supplies 175 mgd of the city's water.

Water Intake Crib is "Lonely Island"

A fifty-year-old home in Lake Erie, four miles from Cleveland

by ALICE HOLTON

LIKE "living on a ship which never goes anywhere" is how the keepers of the water works intake crib, four miles out in Lake Erie, describe their existence. From the shore of Cleveland, Ohio, the "ship" appears to be a huge orange circle floating on the lake.

Actually the crib is a cylinder of steel, 100 feet in diameter, set on end in water 48 feet deep and weighted down by an inner shell of concrete 25 feet thick. It is one of three cribs which supply the city of Cleveland with water, but it is the only one which is constructed above water, hence the only one on which men live for weeks at a time.

The steel sides of the crib extend about 27 feet above the water. A square frame building is built over the crib well to house machinery, a boat which sees infrequent use, and the living quarters and workrooms for the crib keepers.

Above the roof of the building, a tower supports a windmill, weather instruments, a night light, fog horns, and a big bell which must be rung by hand if the lights go out or the fog horns fail. The windmill operates an electric generator and charges batteries for a 32-volt system.

Boat landings are made on the southwest side of the crib, usually the lee. Construction of the five mile tunnel which leads from the crib to the Kirtland Pumping Station began in 1896 and the first water was pumped through it in 1904.

Three crib keepers take turns living the lonely life on the crib. From March through late fall, two keepers at a time are on duty, while the third is ashore for a week. The crib keepers clean the intake well, keep the crib light burning, man the fog horn and relay weather reports, via police radio, to Cleveland's weather station.

Even with these chores, the keepers have time for such things as fishing (for lawyers and pike), reading, gardening, cooking and warding off the spiders and flies which swarm over the crib by the thousands. Gardening consists of caring for a portulaca flower bed which is the particular care of crib keeper

Miss Holton is Publicity Director of the Perfection Stove Co., Cleveland, Ohio.

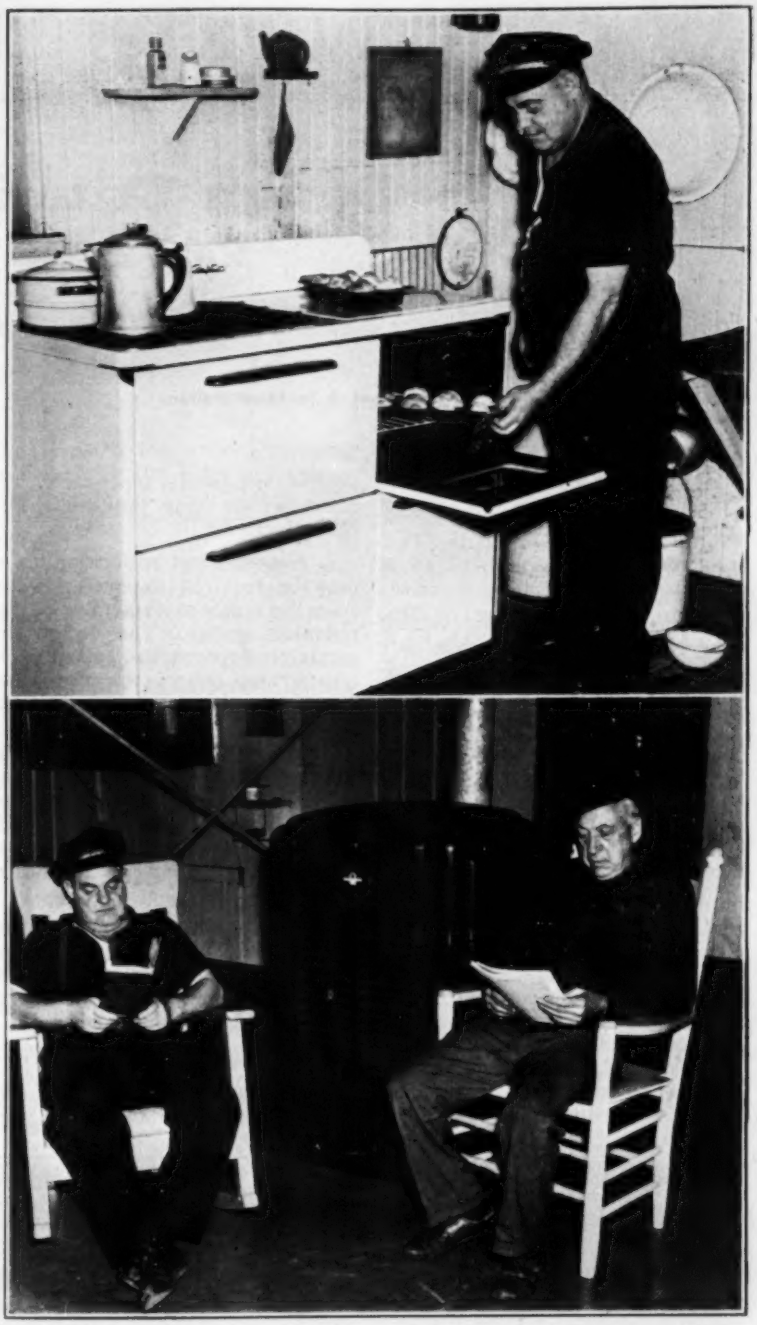
Art Moore. Lee Gruneske is the veteran of the crib keepers. Glenn Hengoed's specialty is cooking and baking, which is not surprising since he is a former Army mess sergeant. And, he turns out some mouth-watering meals on the modern Perfection kerosene range in his immaculate kitchen.

There's only one period of the year when all three crib keepers are on duty simultaneously: from the middle of October to the week before Christmas, when the lake is too rough for small boats to come out and make a landing. During this period, no mail, no newspapers, no visitors reach the crib—even the flies and spiders desert their "stationary ship" when the weather turns cold. The three crib keepers have only each other for company, and the comfort of a small radio powered by a 32-volt battery. Then, a few days before Christmas, a tug comes out to take the trio ashore until spring.

For half a century the crib has been a familiar "lakemark" off downtown Cleveland's shores. Durthe hot summer it feeds 175 million gallons of water each day to the Kirtland Pumping Station.

Above-water cribs at tunnel ends are a thing of the past. The two other tunnels which supply Clevelanders with water terminate in submerged cribs which require no keepers. Some day the city of Cleveland may tear down the one remaining above-water crib and construct a third submerged crib. The water demand of Cleveland being what it is, it hasn't been thought advisable, up to this time, to shut off the tunnel long enough to make the conversion.

For some time to come, Cleveland's lone above-water crib probably will remain a lonely island in Lake Erie, a haven for three crib keepers and for thousands of man-eating spiders and flies—and a decided necessity in Cleveland's supply of water.



KITCHEN—where keeper Hengoed, former Army Mess Sergeant, does the cooking. TWO-WEEK stretches of duty give keepers Hengoed and Grunske time for reading.

Third Edition of "Engineering Contracts and Specifications"

The third edition of "Engineering Contracts and Specifications" has been issued. Published by John Wiley & Sons in March, the book was written by Robert W. Abbett, consulting engineer with Knappen-Tippetts-Abbett-McCarthy of New York.

The book, an exposition of fundamental methods and principles, tells how to write contracts and specifications, and serves as a legal guide in the administration of construction work. The author has rewritten approximately half of his volume and expanded portions throughout. Representative of these changes is the new material on legal principles, joint venture and incentive-type contracts, cost-plus-fixed-fee contracts, construction insurance, bonding practice, contracts for architectural and engineering services, and specification writing.

The third edition of "Engineering Contracts and Specifications" contains 429 pages and is priced at $6.00.

WATER WORKS PRACTICES

Design Criteria
Part 2

The Twelfth of a Series

by GEORGE E. SYMONS, Ph.D., Consultant & Technical Editor, Larchmont, N. Y.

THIS installment continues and completes the subject of Design Criteria.

B . . . Source of Supply

1 . . SURFACE WATER

a. Lakes, rivers, or impounding reservoirs must have sufficient *safe yield* (minimum gallons per day available under most adverse drought conditions), to meet *maximum draft* for the longest drought period recorded or predicted.

b. Required capacity of storage to meet these conditions can be calculated from a mass diagram (cumulative curve of flow and demand) with due allowances for evaporation and siltation. (See Lecture on "Impounding Reservoirs.")

c. The design of a dam to supply storage by impounding reservoirs, and its location depends on the required storage capacity, topography and other factors. (See Lecture on "Impounding Reservoirs.")

d. Intake structures required in storage reservoirs, lakes or river depend on capacity, topography, climate (winter icing problems), and other factors.

e. Aqueduct or transmission mains may be required to convey water from the source to a reservoir or distribution system. The design depends on topography, capacity required and relative locations and elevations of source and distribution.

(1) Aqueducts may include canals, flumes, siphons, tunnels or other channels flowing at atmospheric or other pressure.

(2) Transmission mains usually flow under pressure and may be of cast iron pipe, steel or concrete.

f. Low service pumping station requirements and design depend on topography and relative elevations of supply, source and treatment plant or distribution system.

2 . . GROUND WATER

a. The aquifer comprises the supply reservoir. Its ability to yield water in the amounts desired can be determined from test wells.

b. The number, size, depth and spacing of wells will depend on the maximum safe yield and the maximum demand. (See Lectures on "Location and Construction of Wells" and "Well Capacity and Development.")

C . . . Treatment

1 . . SURFACE WATERS

a. Surface waters may contain turbidity, suspended matter, color, tastes and odors, hardness, bacteria, and in some cases iron, manganese, and industrial wastes.

To be acceptable for drinking purposes water should be free of all of these items, except hardness, which, however, should be reduced when too high.

b. The type of treatment employed depends on the kind and extent of impurities to be removed. The size of the treatment plant depends on the capacity requirements to meet the demand. (See Section A of this lecture.)

(1) Turbidity, color, and bacteria are largely removed by coagulation, sedimentation and filtration.

(2) Bacteria are further reduced or eliminated by disinfection processes, usually chlorination.

(3) Tastes and odors may be removed by activated carbon treatment, aeration, or chlorination, or a combination of these processes.

(4) Color removal may be affected by activated carbon treatment or, too some extent, chlorination.

(5) Hardness is removed by softening, either by lime, lime-soda, or ion-exchange processes.

(6) Industrial wastes, particularly of the phenolic type, may be removed by excess chlorine, activated carbon, or chlorine dioxide.

(7) Iron and manganese may be

RESERVOIR and intake tower—Fort Smith, Ark.

removed by aeration and filtration, and softening.

c. The size and number of the treatment units depends on the capacity requirements of the plant, the efficiency and rated capacity of the individual units.

(1) Coagulation basins, sedimentation tanks, filters, etc., have rated capacities according to standards and designs which have been developed by the AWWA, designing engineers, and equipment manufacturers.

(2) Equipment for chlorination, chemical feeding and other treatments have design capacities developed by equipment manufacturers.

(3) Factors of treatment unit and equipment design and capacity will be presented in later lectures on the various treatment processes.

2 . . Ground Waters

a. Ground waters usually are free of turbidity, color, taste and odors, and bacteria, but it may be hard or corrosive and, in some cases, may contain iron, manganese and hydrogen sulfide.

b. Treatment, if necessary at all, will usually consist only of chlorination as a protective measure.

c. Removal of hardness, iron and manganese will require chemical treatment and filtration. If the water is corrosive, the water will require pH adjustment, usually with lime.

3 . . Laboratory Control

The more varied and complex the treatment, the more complete must be the laboratory which is used for the control of chemical and bacteriological treatment processes.

D . . . Pressure

1 . . Low Pressure

a. Surface water supplies below the elevation of treatment works must have a low service pumping station to lift the water to an elevation from which it can flow by gravity through the treatment process units.

(1) Factors of design include suction lift (if necessary), discharge pressure, capacity, power and control.

(2) Pressures at the pump need be sufficient only to overcome friction losses in the transmission line and to discharge water at the elevation desired.

b. Ground water supplies utilize low service pumping at low discharge pressures only when the water is pumped to a treatment plant or to a storage reservoir from which it is pumped to a distribution system.

LABORATORY for chemical control—Cedar Rapids, Iowa

2 . . High Service

a. Domestic uses ordinarily require a minimum pressure at the consumer's home of not less than 20 lb per sq in., preferably 30 to 35 psi.—50 to 65 psi. is recommended for normal supply in building up to ten stories.

b. Pressure losses due to friction and to differences in elevation between pump station and consumers' services require a greater pressure at the pump discharge than at the service tap.

(1) Many plants carry pressures 30 to 50 psi. greater at the pump discharge than on the system in order to maintain minimum pressures at all points on the system.

(2) Where the community is hilly or the water supply at an elevation below the city, pressures at the pump may be 100 to 120 psi.

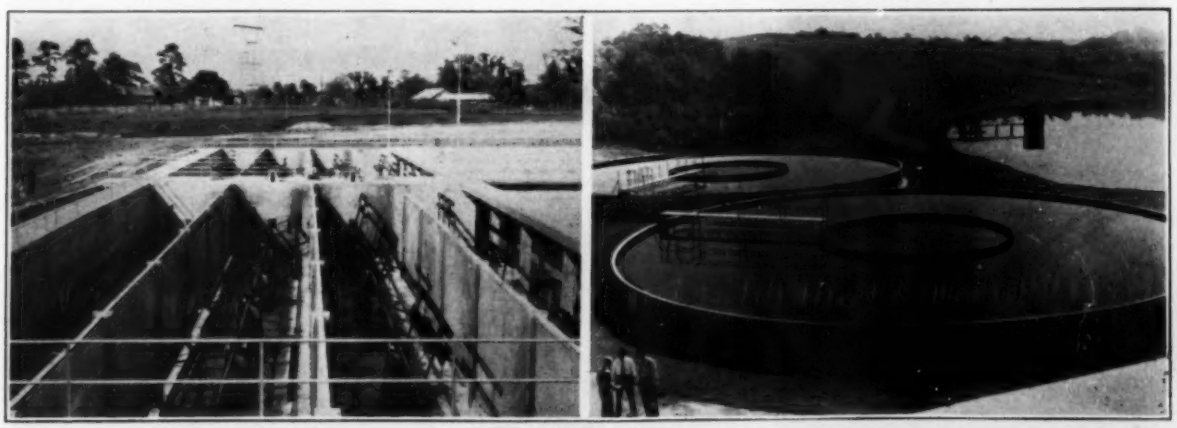
(3) If the ground elevation throughout the city requires wide variation in pressure ranges, two or more distribution systems (at different pressures) may be used.

c. Well field pumps may operate at high pressure and discharge directly into the distribution system.

3 . . Booster Stations

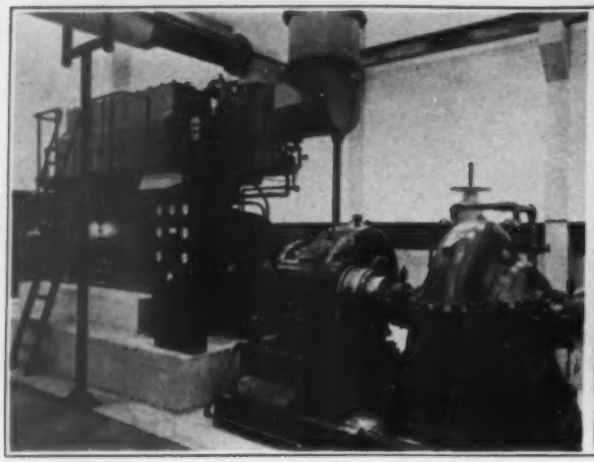
a. Pressure in outlying or high areas may be maintained by booster pumps located on the distribution system or by elevated storage tanks which are filled during off peak periods.

b. Booster pumps can be controlled by pressure or by a combination of pressure and flow.



TREATMENT equipment

Flocculating units—Macon, Ga. Settling units—Greensburgh, Pa.



STANDBY power, Diesel engine—Miami, Fla.

DISTRIBUTION system, Venturi Meters and cone valves

4 . . Fire Pressure

a. Fire service requires greater pressure than for domestic use. For effective fire fighting, water must issue from the fire hose nozzle with velocity enough to reach considerable height and in ample volume.

b. Unless separate fire systems are provided, water pressures in distribution systems are usually increased by 20 psi or more during fires.

c. Additional pressure may be obtained by fire pumpers.

E . . . Power

1 . . Choice

a. Steam, electricity, petroleum products, gas, water and wind may be the source of power for pumping at desired pressures.

b. Location and accessibility of a pumping station with respect to source and cost may be determining factors in the selection of the kind of power used.

c. Electricity is usually employed for operating auxiliary equipment (chemical feeders, controls, etc.).

2 . . Standby

a. Standby power must be provided not only as extra units but also as alternate sources.

b. Where steam is used, extra boilers are provided, as are alternate sources of coal, oil or gas if these are the fuels.

c. When electricity is the power, standby power may be alternate power lines and sources; generators operating from diesel or gas engines; or gas, gasoline or diesel engines directly connected to pumping units.

F . . . Equipment

Design factors in the selection or specifications of equipment are many and varied:

Pumps—Capacity, pressure, efficiency, power and type.

Meters—Accuracy, loss-of-head, recovery, laying length, weight, etc.

Chemical Feeders—Type of feed (dry, solution, volumetric, gravimetric) capacity, accuracy, size.

Coagulation Units—Type of flow (vertical or horizontal), baffle arrangement, detention time.

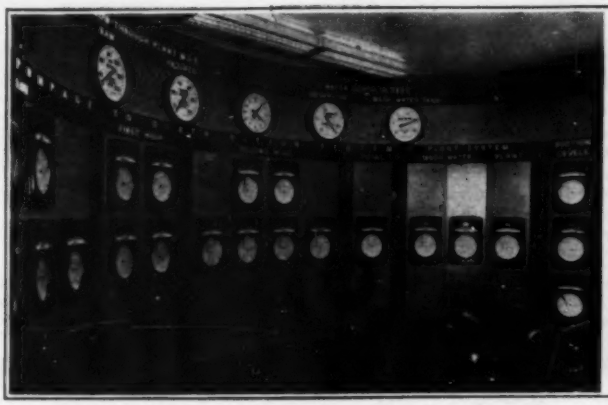
Settling Units—Shape (rectangular, circular), overflow rate, sludge removal facilities.

Filters—Type of bottom, depth, sand size, rate, surface wash, rate controllers, back wash system, gauges, valves.

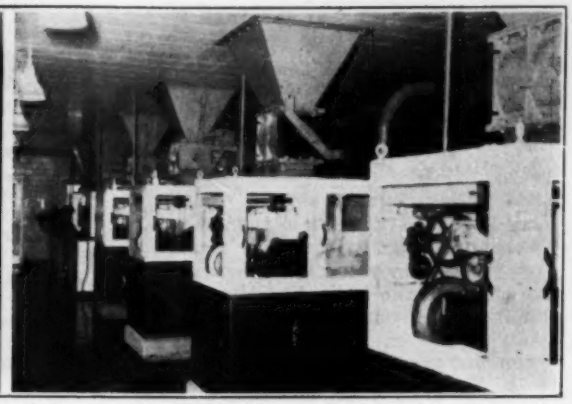
Controls—Location and function (pump, pressure, flow, filter rate, filter wash, chemical feed) housing (central vs. unit) electric or pneumatic, type of gauge, recorder or indicator.

ELEVATED storage—Arlington Co., Va.

FILTER operating gallery—Dayton, Ohio



CONTROL panel, Nottingham Plant—Cleve'and, Ohio



CHEMICAL feeders—Norfolk, Va.

Chlorine Feeder—Capacity, point of application, method of control, water requirement, type of feed, etc.

G . . . Distribution

1 . . MAINS

a. Supply mains convey water from pumping or reservoir to various sections of the city; arterial mains are secondary feeders; minor distributors connect arteries and supply individual areas.

b. Size, length, kind of pipe, location and type of valves and hydrants, provisions for extensions, interconnection, friction, head loss, etc., are all factors in planning either a new distribution system or an extension.

2 . . STORAGE

a. Need for storage may be to supply extra water during peak consumption demand, or to supply fire demands in addition to normal demands at peak consumption periods.

b. Storage may be in distributor reservoir on high elevations, ground level storage with booster pumps, or elevated tank storage.

c. Capacity of storage depends on its function in the system; the height of elevated tanks depends on pressure considerations. Elevated tanks may be steel or pre-stressed concrete.

H . . . Architecture

1 . . BUILDINGS

a. Pumping stations, filter plants, chlorinating stations, elevated storage tanks and all structures for waterworks purposes should be designed as attractive as possible to aid in the appearance of the neighborhood and to create public confidence and good will.

b. Factors in design include fireproof construction, ample space for equipment, heating, lighting ventilation, drainage, and interior and exterior decoration.

c. Where booster stations are necessary in residential areas, architectural design in the form of a modern home makes the station less conspicuous and does not adversely affect residential property values.

2 . . LANDSCAPES

a. Open storage reservoirs may need protection from vandals but with attractive landscaping.

b. Water works grounds when landscaped with lawns, shrubs, and flower beds attract visitors and induce public esteem.

3 . . ELEVATED STORAGE

Whether steel or concrete, elevated tanks can be made to add an attractive note to the landscape. Various shapes exist as standard patterns or special shapes are possible.

I . . . Personal Preference

1 . . ENGINEERING CONSIDERATIONS

a. All designing engineers desire that any water works system and its component parts should produce and

ELEVATED storage—Greensboro, N.C.

ARCHITECTURAL beauty—Norfolk, Va.

deliver its product at the highest possible efficiency, best service and low cost.

b. Fundamental considerations of engineering principles must control basic design factors.

2 . . INDIVIDUAL CONSIDERATION

a. Every engineer worthy of his salt should have a certain amount of imagination and ingenuity which can adapt fundamental engineering concepts to the individual situation and produce something besides stereotypes, even while employing standard units.

b. Most engineers will have preferences as to equipment units although they may specify alternates. These preferences may be based on performance, service available, or simply a record of satisfactory dealings of the manufacturer. Actual purchase of equipment may depend on cost.

c. Most engineers, too, will design a water works layout, spacing and equipment to give the operator maximum convenience and efficiency of operation.

Correction to page 26, Jan. 1954 issue

R. K. Peterson, Field Engineer, Edward E. Johnson, Inc., writes, "In your article on 'Location and Construction of Wells,' there is one point which may mislead a lot of readers who are not too familiar with water wells. That is the table of yields from Babbitt and Doland's 'Water Supply Engineering'. This table will tend to give people the impression that the yield of wells is proportional to the diameter rather than a logarithmic function."

When queried on the point, Prof. Babbitt wrote that "On rereading the table in the book, it does indicate that a straight line relationship between O and D, and peculiarly such a relationship does exist in practice in the construction of drilled wells. Of course, the hydraulic formula indicates something quite different. The fact that the theoretical relationship is

$$Q = \frac{he^2 - hw^2}{\log \frac{r^e}{r^w}}$$

must be emphasized in a future publication."

J . . . Summary

Design criteria for water supply systems are many and varied. Basic factors in these criteria have been outlined in this lecture. Details of many of these factors will be presented in future lectures on Pumping, Distribution, Chemical Coagulation, Sedimentation, Filtration and Disinfection, etc.

K . . . References on Design Criteria

Babbitt & Doland—"Water Supply Engineering" (McGraw-Hill)

Hardenbergh—"Water Supply and Purification" (International Text Book Co.)

Steel—"Water Supply and Sewerage" (McGraw-Hill)

NEXT LECTURE

Hydraulics and Flow Measurement—Part 1

Causes of 1953 Water Supply Shortages

A Critical Survey by the U.S.G.S.

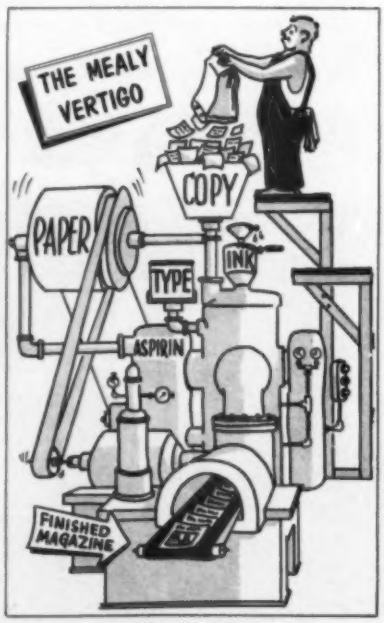
Of the Nation's public water supply systems 1,072 were unable to supply the full demands of their customers during the summer of 1953. To determine the true cause of this deficiency in so important a field as water supply service, the U.S. Geological Survey made a critical 48-state survey. The results and findings have just been made available in a report entitled "Public Water Supply Shortages—1953." The report reveals the following:

Reasons for shortages were placed in three categories: population growth or unusual seasonal fluctuation in use; increase in industrial use; and failure of supply. Fifty-one per cent of the 1,072 municipalities reported shortages because of population growth and increased seasonal use; one per cent because of increase in industrial use; 34 per cent because of supply failure; and 14 per cent because of a combination of reasons. Most of the shortages were experienced by small towns.

Of the 1,072 municipalities involved, 54 per cent used ground water, 39 per cent surface water, and 7 per cent both.

Types of shortages were also classified into three categories: inadequate supply; inadequate treatment facilities; and inadequate distribution facilities. Inadequate supply was considered to be an insufficient supply at the water plant and might be due to insufficient pumping capacity, too few wells, or too small a pipeline to a stream or reservoir as well as a supply failure. Fifty-five per cent of the shortages were due to demands exceeding the supply; four per cent to inadequate treatment facilities; 20 per cent to inadequate distribution facilities, and 21 per cent to a combination of types.

"Public Water-Supply Shortages, 1953" (Supplement No. 3 to the Water Resources Review) is free on application to the Water Resources Review, U. S. Geological Survey, Washington 25, D. C.



An Editor's Dream
(Cartoon by Kable Printing Co.)

Dallas—Fort Worth Take Joint Action on Water Supply

The Mayor of Dallas voiced willingness to co-operate with Fort Worth on problems of water supply. Water has become perhaps the most urgent problem of this area, and assurance of an adequate supply calls for joint action.

Dallas, Fort Worth and other North Texas communities depend on the Trinity Watershed for their water. They all can benefit by joining forces in the location and building of future reservoirs and pipelines.

The Trinity and its tributary streams can provide all the water that this section is likely to need. The problem is to hold it here. This may require the building of bigger reservoirs than any now contemplated. And it will mean successful resistance to South Texas political efforts to have this water pre-empted for a fantastic canal to irrigate the Duchy of Duvak.

Problems of Small Water Systems and How They Can Be Solved

by JOHN A. DIETRICK, *Treasurer, Northern Cambria Water Co.*
Harrisburg, Pennsylvania

A budget is both an essential operating tool and a good guide to the amount of money available for various purposes.

A SMALL water system may be defined as one which regularly employs one or two men. It may be difficult to envisage a system where one man does practically all the work; where water usage is 200,000 to 250,000 gpd and chlorine use less than one lb. per day, but there are such systems and they are as important to the daily life and health of the small communities, as larger systems are to the larger communities.

Because of the limiting factors imposed by its small size, at times, the operation of a small water system becomes infinitely more difficult than that of a larger system. One reason for this is that we do not have the well trained crews and equipment to apply to the solution of some of our operating problems. A break in a 10-in. supply line at 130 lbs. pressure can be quite a job for a one-man operation to repair. We have seen it done by only two men, and service restored in a matter of 6 hours after the break was reported. Speaking of solutions, we have yet to find out why the main breaks and other maintenance problems always happen on a week end, or on washday, or at a temperature of 5 below zero!

In discussing the next problem, I may appear to unduly stress finances, but it has been my observation and experience that inadequate income and financial resources have been perhaps the greatest limiting factors affecting the growth, man power, equipment and adequate service standards of small water systems. While the money field may seem to many operators specifically the business of the general office, which it quite properly is, it also is inextricably woven into daily operation problems. It must of necessity be of the deepest concern to those of us who are charged with the responsibility of operation and daily contact with the public. The size of our pay checks, and standards of our service, etc., are constantly affected by money, or frequently by the lack of it.

Small Plants—Small Salaries

Historically, many of our small water systems grew up from a modest start. They were organized because a mining company, or a lumber company, or another industry wanted water piped in so they could attract an adequate labor force. The job of superintendence frequently was an off-time responsibility of the plant superintendent. The honor of keeping the books was given to a local citizen of probity and character and for his work he sometimes was paid as high as $250 per year; sometimes he received only the honor!

A local superintendent, under these conditions, often found it hard to trade the honor with the local grocer for food, and left to more remunerative fields. There are many factual examples: I can show you records where a local water utility manager, hired as late as 8 years ago for $85.00 per month, was expected to devote his full time to the company. These conditions, happily, are no longer prevalent in most small communities.

In this particular field it is the serious duty of general management to take a long hard look at facts and govern their rate schedules accordingly. Needless to say, their efforts in this field should have the earnest and enthusiastic support of the operator.

A Budget Is Essential

Budgetary control in small water systems is a difficult and controversial problem to solve. It seems almost impossible at times for an operator to realize that cash flow through necessary channels is the life-blood of the company, and that his own financial well-being depends upon it. We urge all operators to make a real effort to understand it as one secret of good overall operation. Budgets are a necessary evil which, from an operating standpoint, are considerable of a nuisance. A bad break or other unexpected maintenance problem is just a matter of adjusting accounts in a larger system, but in a small system it can wipe out the entire materials and supply budget at one time.

Nevertheless, we have found that in a small water company a budget is both an essential operating tool and a good guide to the amount of money available for various purposes. We have found, however, that it is useless to set it up on the usual accounting basis, subdividing for depreciation, etc. We set it up strictly on a "cash and what for" basis and, as years of experience and records are built into it, we find this system increasingly more workable.

Another factor under the heading of money is to persuade the directors of the system that the rate structure should include an adequate depreciation allowance. It should be an established principle of operation that depreciation cash should go only to reduce debt or install a new plant. Reduction of debt is important, but we believe that the bulk of the money should go into plant improvement. This may seem like financial heresy, but I believe you will be surprised at the number of able financial men in the water works field who believe in it as sound public and financial policy, as well as good water works operating practice.

Manager's Qualifications

To pass from a pre-occupation with money into the field of personnel is an easy step, for it is in the adequacy of the former that much of our solution to the personnel problem will be

Mr. Dietrick's paper was presented at the twenty-sixth annual conference of the Pennsylvania Water Works Operators' Assn.

The small water works operator is a somewhat special person to locate and keep employed, particularly in this age of specialization.

found. The small water works operator, unless he has grown up with a small water system, is a somewhat special person to locate and keep employed, particularly in this age of specialization.

A small water company needs what is usually called a working manager. This is not intended to mean that managers of larger companies do not work, for they do, and the stresses and strains of their work are as difficult to bear as those of managers in the small companies. However, the superintendent of a small company very frequently digs the ditch, clamps the leak or renews the line or makes the tap and backfills the hole all by himself. If he is afraid to get dirty or get into the ditch he just does not fit into or stay long in the small water works picture.

He definitely should be a man of over-all ability. He should have a reasonable amount of knowledge of arithmetic to be able to work out the minor hydraulic, cost and operating problems—so many of which seem to get down to figures. He should be a man willing to understand and cooperate with company policy and explain it to the consuming public. He should be able to explain the consumer's viewpoint to the general office and be able to recognize a consumer complaint valid enough to justify remedial action upon the part of the company. He should have some knowledge of bookkeeping, for in many small companies he also keeps the consumers' records, makes out the billing and collections and takes care of deposits. He should be possessed with a willingness to try out new methods, equipment, etc.

He also should be one who can get along in a working fashion with the general public. It is upon this requirement which many men, perfectly able to carry out the other functions previously enumerated, flounder. They are good men but, to use a common phrase, "they just can't take it." We do not know what the experience of larger companies is but a small water works man just must develop a certain amount of impenetrable hide, public relations experts to the contrary notwithstanding. If he does not, he gets himself so worked up that he is unable to properly carry out the many daily functions that are his responsibility. In this field it becomes important for general management to be able to weight the scales well. Any man with the many attributes required obviously must have some to a greater degree than others, thus you must be able to put up with some things in order to accomplish the over-all objective.

The Working Day

A small water works operator usually starts his day with a trip to the chlorinator. He must be able to figure the dosage, rate of injection, etc., and keep the necessary records and reports. He must be able to make minor repairs and adjustments to chlorinating equipment, and know about when a major reservicing job is due. We have found it sound economy and good operating policy to have a factory trained service engineer make periodic repair visits to our metering and chlorinating plant, since we feel it is unjust to expect our local operator to have the detailed knowledge that factory-trained men have.

The operator frequently may be required to deal with taste and odor troubles. In a larger system this problem usually is handled by the chemists and solved under their direction. A small plant operator is not a chemist, nor does he have one at his beck and call. In this particular province we have so far been able to work out a satisfactory solution by using the help of the sanitary engineering and chemical branches of the Department of Health, as well as that of the chemist of one of our much larger brothers in the water field. We are thankful that we have this opportunity to publicly express our profound and sincere appreciation to those men for the real and timely help they have given us.

Specialists Are Needed

We speak appreciatively of one chemist who came out to our reservoirs and showed us just what algae to look for and expect at various times of the year, explained the factors that cause these conditions, and suggested treatments. That's a lot of help to a small company.

We recall another time when, after a prolonged hot spell, we had a very sharp drop in temperature for a period of several days and suddenly the water began to smell. It was our first experience with something of that kind and we just did not know what to do. We were made aware by the customer complaints that something had to be done and fast. We called in the department of health, and technical men were quick to respond. An analysis was made and it was decided that the reservoir had turned over prematurely and had stirred up an alga named "annabena." It was the first we had known that a reservoir turned over, and that anything named "anna" could be such a troublemaker.

Various means of control were discussed, and it was decided that since we had a spare chlorinator we should try to burn up the taste with chlorine. In this instance we were pumping from one reservoir through an 8-in. force main, 5,800 ft. long. The force main emptied into a ravine, where the water flowed 1,300 ft. down hill to the distributing reservoir and thus received some aeration. We applied plenty of chlorine and at the end of the force main, which provided 40 minutes contact, we found we had a chlorine residual of 2.0 ppm. After the drop down hill into the distribution reservoir, the residual decreased to about .5 ppm. We next gave the distribution reservoir a small dosage of a copper sulphate, and flushed the entire distribution system the following day.

Very shortly thereafter the consumer complaints subsided and the local operator, after catching up on his sleep, felt he could safely appear downtown again. Since then, as a matter of routine, we watch the reservoirs and do not hesitate to use proper dosages of copper sulphate or chlorine as the case may be. We reiterate our indebtedness to those who solved our problem, and we would recommend to operators of small plants that they discuss their problems with real specialists. They can't do your work for you but their wide experience and detailed knowledge, gained from a multitude of problems, generally will be made available.

We would like also to pay our respects to those men in engineering and management positions in the larger companies who have so willingly and selflessly aided many of our smaller water companies. The writer is deeply indebted to many of them. In fact, we'd say that we have received a very liberal education over the luncheon table. We might also mention, in passing, the much maligned "peddler." While at times his advice may seem confusing, depending upon what he is

Operators of small plants may receive a liberal education over the luncheon table.

trying to sell, nevertheless the small water works man will find that peddlers generally are a sincere, serious and honest bunch who can be a great deal of help to him.

As we continue on the subject of operations we would stress the importance of frequent trips over the properties on the part of the men charged with general responsibility. There are reports and reporters, records and recorders but nothing is so valuable as first-hand knowledge of the properties and problems engendered by actual contact with them. It is the writer's conviction that no small waterworks property can be made to function in a well co-ordinated manner without frequent personal visits on the part of general officers.

Reforestation Benefits

We have carried out a program of reforestration over a period of several years with good results. Our planting is almost entirely conifers. It has returned substantial benefits in improved water quality and definitely increased quantity. We are informed that prior to reforestration the run feeding our one reservoir went completely dry for periods as long as two months. At the worst of the 1952 drought we had a steady minimum flow of 30,000 gpd. Not a great deal, but a cumulative value of roughly two million gallons of water we otherwise would not have had. In 1953, our minimum yield did not drop below 50,000 gpd.

In another water-shed we have been able through the co-operation of the Pennsylvania Game Commission, Department of Forest and Waters, and the Philipsburg Rod and Gun Club, to inaugurate a program of planting that will have very valuable long term benefits. We buy the trees and they plant them. Our only restriction is that none of these trees shall be planted upon land owned by the water company. Operators of small as well as large systems, will find these departments quite willing to be of help to them, and the co-operation cannot help but bring about an improved water quality and yield.

Water Bill Payments

By keeping a record we found that 56 per cent of our money came in through the mail, and that 92 per cent of payments were made during the hours of 10 A.M. and 4 P.M. This record has enabled us to operate our offices on a 20 hr. per week basis, and thus makes an attractive job for a married woman who does not have time for a full 40 hr. week. We are able to pay a respectable hourly rate for the job, and keep the monthly total within reasonable limits.

We have been giving consideration to quarterly billing, as a means of relief from increased operating expense, but because of the higher working capital requirements, possible delinquencies, and other problems, our directorates have been slow to take it up. It does seem, though, as if it will be an inevitable development.

Electronic line locators are a useful tool for small systems whose maps are inadequate, and their use may save considerable amounts in digging costs.

Economical Equipment

In the field of materials, supplies, and equipment the management can do a great deal to lessen the burden upon the operator—and at the same time can achieve operating economies of substantial value. Water-works manufacturers have developed an enormous and varied product to pick from.

We have paid particular attention to all items that enable most of the repairs and installations to be done well by one man and, at the most, by two men. In one property we have come to use exclusively for service lines, copper tubing with flared connections. The cost of copper is obviously much greater than galvanized pipe but the substantial savings in labor are such that its use is fully justified.

Pipe Repairs

We have found that by adopting split-repair clamps, particularly of the mechanical joint variety, we are able to make a repair of a break with little or no trouble and usually with one man. We have also found no-thread couplings of the greatest value, particularly in those areas where the distribution lines and service lines are galvanized.

A leak formerly would have meant threading a union and coupling piece in the ditch. Now we just saw out the leaking section, and use no-thread couplings to install a new piece of pipe. Many of these repairs will outlast the service line, and should the service line subsequently be replaced, the fittings can be salvaged and reused. This method has much value, especially in winter weather, as a temporary repair can be made until better weather permits complete replacement. There are various fittings that are extremely useful to a small water system, but we have found it is better to maintain a limited inventory narrowed down to a few of the units most useful to each system.

Management can do a great deal to lessen the burden upon the operator—and can achieve operating economies of substantial value.

The Useful Jeep

We have found the jeep a very useful tool in a small water system. At first we endeavored to use it as the sole means of trucking and transportation, but found the overhead of maintaining its multiple gear system a rather formidable proposition. Further, it's a difficult unit to heat in winter. We now use it as specialized equipment. Equipped with a dozer blade and winch, we have found it very useful in back filling and in setting heavy items such as fire hydrants.

By use of a trailer, much difficult hauling can be accomplished at considerable savings in truck wear and tear. We do not purchase a new truck, but shop around for a good second hand model.

We have had excellent experience with a motor-driven horizontal boring machine for such work as installing casing under railroads, and service lines under highways. It can be a most useful tool when properly handled and accomplish a substantial savings; it limits the amount of opening required and also saves substantial labor costs. In a one-man system it is necessary to employ an extra man to use the boring machine, as the unit is too heavy for one man to handle. One man must work ahead of the machine with a wrench to make the necessary holds on the pipe as additional sections are added. We have our own bits made up for us by local welders, using mine-cutting bits with extra hard tips.

Line and Leak Locators

We have had good results with the so-called electronic line locaters. Their usefulness is somewhat impaired by their delicacy, but as time goes on the operators learn to shield these units from the frequent bumps that water works operation entails. When repairs

A main line meter and recording pressure gauge are most valuable tools—and the smaller the system, the more important they become.

are needed it sometimes is difficult to locate a repairman who has the right kind of repair equipment. They are a useful tool for small systems whose maps are inadequate, and their use may save considerable amounts in digging costs.

In the field of leak location, we found the geophone our most useful tool—after we found out just what the various sounds meant. We follow the standard procedure of sounding fire-hydrants and valve boxes at night, noting the noisy areas. Then during the daytime the men go from service to service, using the curb key or going into the cellar and listening to the various service lines. If the survey has not pinned the leak upon a service line, we return to the main. It is significant that six out of seven leaks recently located drained underground and did not show on the surface.

Meter and Gauge Records

We would like to emphasize the importance of using a main line meter and recording pressure gauge. We consider these units most valuable tools in any small water works system, and the smaller the system the more important they become. We do believe the recording variety is preferable, for in a small system, manpower just cannot watch everything at all times. By using recording meters and gauges, the operator can quickly locate any unusual developments taking place. Operators of small water systems have told us they do not need such units but, our experience has just been the opposite. We are convinced that we cannot attain really efficient operation until both types of units are in operation on a system. The ability to pinpoint times of unusual occurrences, night flows which indicate leakage, etc., are so useful that we believe these units are water works tools of the utmost importance. They further serve a good purpose by illustrating graphically operating practices that the operator wishes to bring to the attention of management, and vice versa.

In this paper we have tried to describe some of the many problems confronting a small water system operator; his importance; and the necessity for close co-operation between him and management. Co-operation results in the best use of manpower, money and materials, and the small water systems are thereby enabled to render reasonably adequate standards of service.

Richard H. Gould Receives A.S.C.E. Citation

Named "Metropolitan Engineer of the Year" for development of sewage treatment

The Metropolitan Section of the American Society of Civil Engineers has announced the selection, by its Board of Directors, of Richard H. Gould, as Metropolitan Engineer of the Year.

Mr. Gould was formerly Director of the Division of Sewage Disposal, New York City Department of Public Works. He achieved wide distinction for his development of Municipal sewage treatment methods, and some of his processes have been adopted in other parts of the world.

The Board's citation stated that the choice of Mr. Gould was "for outstanding creative contributions to the engineering profession in the New York-New Jersey Metropolitan area by his inventive developments in the art of sewage treatment as shown in the progressive construction of treatment works for the entire city of New York."

In naming Mr. Gould the Metropolitan Engineer of the Year, the Board called attention to the fact that "there are ten large modern sewage treatment works in operation which were designed, constructed and operated under his direct supervision." Their total cost is approximately $144,000,000. The Board emphasized that "control of sewage pollution in New York City is the largest single sanitary engineering problem in the country today."

The citation went on to say:

"Notable in the design of these works has been the pioneering in new processes and the improvement of old methods. Mr. Gould's inventive and improved processes include 'step aeration,' a modification of the activated sludge process, which has saved many millions of dollars for the City of New York in the construction cost of new plants. The 'high rate activated sludge' process likewise has resulted in large savings in construction and operating costs. His studies of final settling tanks for activated sludge have led to radical changes in these important units of the treatment processes that have influenced design practice."

Mr. Gould is associated in New York with the firm of Greeley and Hansen, Chicago Consulting Engineers.

Correction to Article on Oxidation-Reduction Potential

Robert Shapiro, author of the article on "Oxidation-Reduction Potential," pages 185-188 of our April issue, has requested that we give credit to the source of the illustration appearing on page 187.

The illustration is a line drawing titled: "O-R potential laboratory set-up to study changes in liquid without admission of air." It was reproduced from an article "Application of Oxidation-Reduction Potentials to the Control of Sewage Treatment Processes," Sew. & Ind. Wastes, 25:1003, September 1953. Frederick E. Nussberger, Senior Chemist, Dept. of Public Works, New York City, is the author of that article.

Industry and City Cooperate in Water Reclamation

Waste water from the water-shy city of Ventura, Calif., will be reclaimed for industrial use by a new plant being built by the Shell Oil Co.

Shell, the largest water user in the section, decided to erect the plant in order to guarantee a constant supply of water for its operations and to ease the requirements of the local water supply.

The plant will be the first of its kind constructed in the West by a private company. It will be located adjacent to the Ventura Sewage Disposal Plant on property leased from Ventura.

Shell will underwrite expenses of the plant for 20 years, at which time the title to the property will be conveyed to the city. In exchange the company receives water free of charge for 20 years.

A Modified Rational Formula for Storm Water Runoff

New rainfall information can be utilized in this practical form of computation

by **CHESTER J. ORDON**, *Assoc. Prof., Civil Engineering Dept., Wayne Univ., Detroit, Mich.*

FOR a great many years, practicing engineers have been using the rational formula for computing storm water runoff from drainage areas. The formula has always had the advantage of being easy to use and practical for the engineer who is not a specialist in the field of hydrology.

Recently the results of an accumulation of data and experience on rainfall-runoff relationships have found their way into print as discussions and new methods for computing storm water runoff. There must be many engineers who are a little troubled by these methods, either because they don't understand the methods, or because they do not have data available in their area to apply them.

Newer Concepts

The purpose of this discussion is to incorporate some of the newer concepts with the rational formula thereby bringing it up to date and to illustrate its correct usage.

The formula $Q=c\ i\ a$, like any formula with an assumed coefficient, will always yield acceptable results when the correct values are put into it. A basic understanding of what the factors stand for, and experience and data enough to establish reasonably correct values for c and i, will be required. Let us consider each item in turn.

The area in acres, "a," is usually readily taken from a topographical map and, in almost all instances, it includes all the area tributary to any point in the drainage system.

The value of "i" is usually taken from curves or formulas which are, in the most part, reliable. The development of these curves or formulas requires a separate discussion; only the first basic step will be given here in order to clarify an important point.

Rainfall intensity curves for storms plot in a variety of shapes depending upon whether they have an advanced, medium, or delayed peak. A typical delayed peak storm may look something like that illustrated in Fig. 1.

This curve was plotted from field data which were recorded as in the third line of Table 1. The intensities were recorded in intervals of chronological order.

If we now take these same intensities and rearrange them in order of magnitude reported in line four of Table 1, we arrive at the familiar curve as shown in Fig. 2.

Table I

RECORD OF STORM DATA

Time in minutes	5	10	15	20	25	30	35	40	45	50	60	80	100	120	180	
Observed Precipitation	.14	.35	.49	.60	.73	.83	.92	1.14	1.36	1.50	1.75	2.89	3.83	4.07	4.72	1
Increment	.14	.21	.14	.11	.13	.10	.09	.22	.22	.14	.25	1.14	.94	.24	.65	2
Rate in inches per hour	1.68	2.52	1.68	1.32	1.56	1.20	1.08	2.64	2.64	1.68	1.50	3.42	2.82	0.72	0.65	3
Rate in order of magnitude				3.42				3.17		2.80	2.69	2.42	2.30	1.95	1.32	4

Rainfall Intensity and Concentration

Let us consider the intensity on the duration curve corresponding to 30 minutes and see how it was arrived at. Returning to Fig. 1, we take the maximum 30 minute period (a) and determine the average rate of rainfall over that period. We find that the actual rainfall varied from 1.5 in./hr. to 3.42 in./hr. but averaged 3.22 in./hr. It began 60 minutes after the storm began and ended 1 hour and 30 minutes later. It will be noticed that there is no relation between the time of occurrence of the 30 minute intensity on the duration plot (Fig. 2) and the chronological curve (Fig. 1). This lack of relationship is important because it is the source of a great many misleading and erroneous statements in otherwise reliable references. The duration curve gives the *length* of time over which an *average* intensity of a certain magnitude persisted without telling where it occurred in the storm or how long it had been raining before it did occur. This becomes an important factor in the selection of a value for C.

Although the selection of a value for C seems elementary to most engineers, it is here that most errors and misconceptions take place. Also, by a simple modification of current ideas, it becomes possible to select values of C which will utilize some of the newer concepts in figuring storm water runoff.

First, there can be no correlation between C and the time of concentration. Many references will list values of C in ascending magnitude along with duration of rainfall from the beginning of the storm. Although these tables could be basically correct for a certain constant rate of rain-

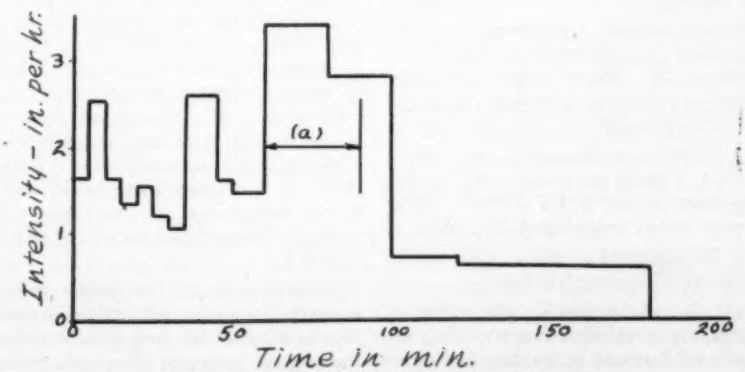


Fig. 1—RATE of rainfall vs. time in chronological order

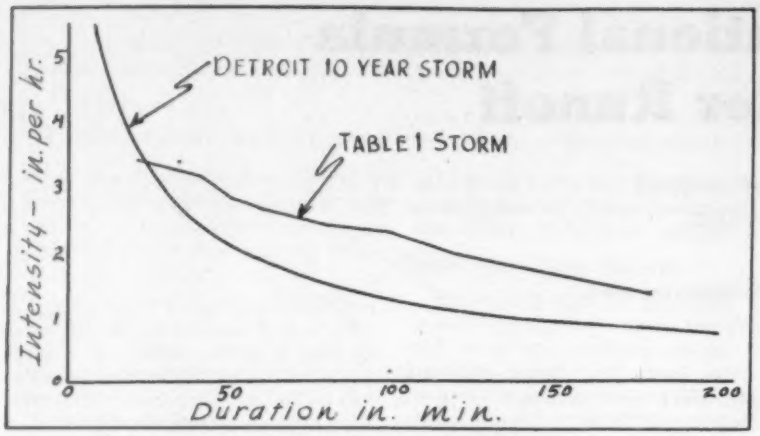


Fig. 2—RAINFALL intensity duration curve

fall, there is no way in which this information can be utilized in the rational formula. The great majority of text books and references known to the author include a tabulation of concentration or duration vs. coefficient of runoff and intend that the engineer use the value of the coefficient corresponding to the time used in the duration curve (Fig. 2).

From the construction of this curve as illustrated above, it becomes obvious that there is no way of determining how long it has been raining when any given intensity is reached. Since we are designing for the maximum condition, the only safe procedure is to assume that it has been raining a sufficient length of time when any given intensity is reached to thoroughly saturate the ground at that time. In the example given, which is an actual storm record in Atlantic City, it had been raining 60 minutes when the 30 minute maximum intensity period began.

Soil Permeability Factor

The second consideration in the selection of C is to consider its variation with the permeability of the soil and factors which affect it. The usual factors taken into consideration are as follows:

1. Antecedent conditions. The ground should always be considered saturated. Other important antecedent conditions are snow cover and frozen ground.

2. Nature of the soil in the watershed. This is most decidedly an important factor and a wealth of data is available concerning it.

3. Intensity of rainfall. This will be discussed in length below.

It is by considering the effect of intensity of rainfall that we bring the rational formula up to date and make it truly rational. Up to now intensity of rainfall has been neglected as a factor, but recent studies have revealed its importance. They have demonstrated that soils have a certain infiltration capacity or ability to absorb water which remains relatively constant regardless of rainfall intensity. In other words rain is absorbed by soil at a certain rate, and all rainfall in additional amount to this runs off. This observation might lead us to modify the rational formula to read as follows:

$$Q = a\,(i - f)$$

Where f = infiltration rate.

To illustrate the affect this would have on the rational formula as now used let us compute the value of C for a typical case. If f for a particular soil remained constant at 0.75 inches per hour, and $i = 1$ inch per hour, then C would equal $0.25/1 = 0.25$. But if $i = 4$ inches per hour on the same soil, then C would equal $3.25/4.0 = 0.815$.

If f were a constant for any given soil and a value could be assigned just as we now assign values of C, then the equation as written above would be correct and provide a very convenient method for computing runoff. Unfortunately, however, as rainfall intensities increase, the film of water, over a watershed area becomes thicker and of more complete coverage thereby increasing the opportunities for infiltration.[3] Although the increase in infiltration rate is appreciable, the per cent of runoff does vary considerably with changes in intensity. The overall effect of this phenomena is of sufficient importance to completely reverse the general pattern in the selection of C.

Returning to the original rational formula $Q = c\,i\,a$, with this new concept in mind, it becomes apparent that the highest values of C would accompany the high intensities that are associated with short time of concentrations and smaller areas. It must be remembered then, that C will vary with intensity as well as the nature of the ground surface, but that we can not utilize any variation with time. As a guide for the selection of C, Fig. 3 was prepared.

The effect of these curves is to assign lower values of C to the lesser intensities which accompany longer time of rainfall concentrations (usually used in conjunction with large areas) and, conversely, high values of C for higher intensities and small areas.

Lower "C" Values Indicated for Large Areas

The idea of using lower values of C for larger areas is not new, for experience has taught drainage men that such must be the case. Many large municipalities have main trunk drains which they feel should be inadequate, but which are carrying the load satisfactorily or which are actually over designed—simply because the designer did not decrease C as his tributary area became larger. This has always been attributed, not to a reduction in C, but rather, to a reduction intensity (i) from that shown in the duration curve. This has been justified by the fact that as areas grow larger, and as one goes further from the center of a storm, the average intensity over the area decreases.

Actually, studies reported by Metcalf and Eddy and Marston show that the effect of this factor is small but appreciable under certain circumstances.[3] The rounding off from the point of peak intensity for a storm is appreciable for intense rainfalls but the lesser intensities, usually associated with larger drainage areas, are wider spread and can be considered uniform over a much larger area. This fact plus the realization that the rain gage data used for plotting our duration curve never measures all storms that register on it at the point of peak intensity, indicates that the effect of rounding off might be nullified altogether.

To explain further, we do not know that our duration curve was based on intensities at the point of *greatest* intensity on *all* storms that register on our rain gage. It can be assumed that there is just as good a chance that a large area in the vicinity of a rain gage will have a higher average rate of rainfall as a lesser average rate. High intensities usually are associated with small areas where the effect has always been recognized as small and the larger areas can be reduced only if the maximum rate of all storms is known; not just the rate at a fixed

point which could be a considerable distance from the storm center.

In the event that readings are adjusted for storm centers, then the rounding off for large areas can become important. After studying curves drawn from experiments made by others and applying the principle that short time of concentrations accompany small areas and long time of concentrations accompany large areas, a series of points was plotted on a graph representing area versus per cent reduction of maximum rainfall intensity. The per cent reduction was arrived at by dividing the average intensity over a given area by the intensity at the point of greatest intensity. This point of greatest intensity was centered over the area.

Since different values would be obtained for different storm durations for any given area, the duration that would most likely be the concentration time for the given area in a municipal drainage problem was used. These points plotted as a straight line on semi-log paper so the following formula was taken from it as being fairly representative of what the reduction might be for municipal drainage problems:

$$F = 1.11 - 0.058 \log A$$

F = reduction
A = area in acres

The factor is used as follows:

$$Q = c\,i\,a\,x\,F$$

For ten thousand acres, F becomes 0.88. This example assumes an inlet time of 15 minutes, an average velocity in pipes, and a somewhat rectangular shaped drainage area. It is admitted that values of F will vary locally. If future experiments reveal important deviations, then more elaborate methods for establishing this factor may become justified. There should be no correction for areas under 500 acres.

In review let us consider the overall effect of these new coefficients on municipal drainage design. Since much higher values of C will be used for smaller areas and higher intensities, then an increase in the size of the laterals and submains in a system will result. As we get into main trunk sewers, sizes will tend to decrease. Higher values of C imply that surcharging of storm drains, and accompanying flooding of basements and streets would occur principally in laterals and sub mains in an otherwise adequately designed collection system.

Summary

The rational formula for computing storm water runoff, $Q = c\,i\,a$, can be modified to utilize newer information on rainfall runoff relationship and still keep its practical form which is already understood and used by so many engineers.

In selecting the value of C, engineers must realize they cannot utilize its variations with time when using it in this equation. The value of C depends on:

1. Permeability of the ground surface and all the factors affecting it such as:
   (a) Antecedent condition
   (b) Snow cover
   (c) Frozen condition
   (d) Vegetation
   (e) Nature of the Soil
2. Rainfall intensity. High intensities increase the value of C whereas lower intensities decrease the value.

The effect of decreasing average intensities over an area as it becomes larger should not be taken into account unless the duration curves are based on data taken from storm centers. If the data are so adjusted, then the effect can be considered and an acceptable value in most cases can be computed from the formula given.

In general, the effect of these modifications will be to increase the size of lateral and sub mains and decrease the size of trunk sewers.

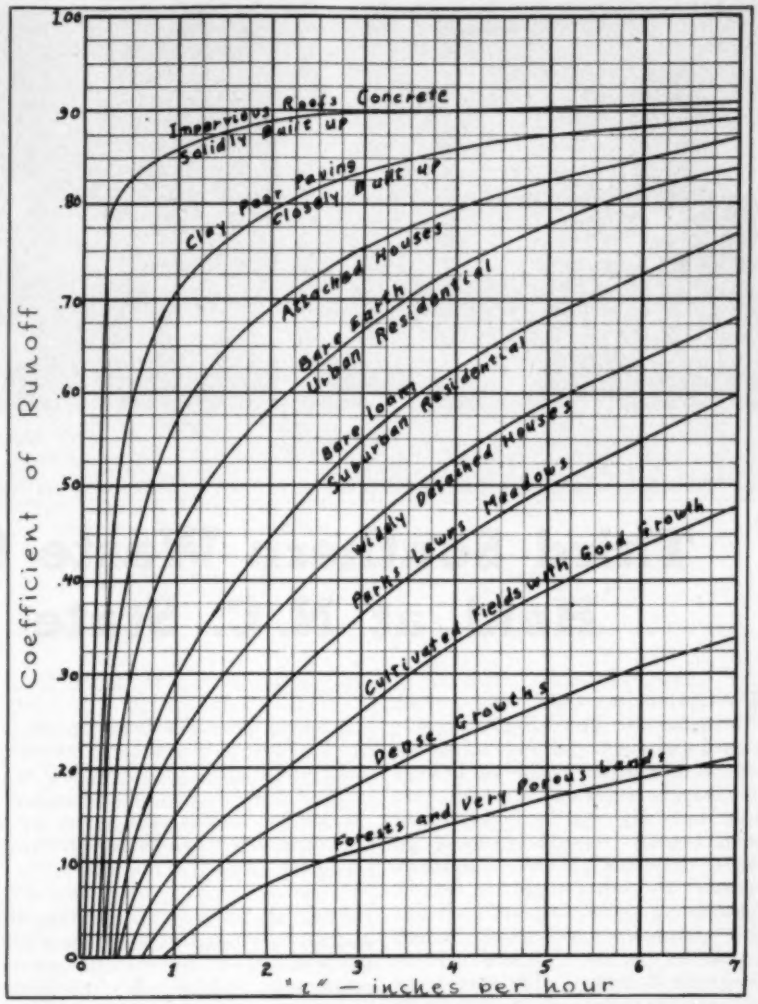


Fig. 3—"C" VALUE as determined by rainfall intensity and nature of ground surface

References

1. A.S.C.E. Manual of Engineering Practice, #28 Hydrology Handbook.
2. A.S.C.E. Transactions. 109, 1217 (1944).
3. A.S.C.E. The Distribution of Intense Rainfall and Some Other Factors in the Design of Storm Water Drains (1924).

Kinsel is new partner in Metcalf & Eddy

The firm of Metcalf & Eddy, consulting engineers, Boston, Mass., has announced that Harry L. Kinsel, who has been a member of the staff for a number of years, has been admitted to the firm as a partner.

OPENING SESSION being welcomed by representative of Chancellor Bostian of N.C. State College. On left of rostrum, Ralph Fuhrman, Keynote speaker and Prof. Ralph Fadum (center) as session chairman. Luncheon session on right.

Third Southern Waste Conference Held at N. C. State College

TWO hundred and ten persons attended the Third Southern Municipal and Industrial Waste Conference at North Carolina State College in Raleigh on March 19 and 20th. The two day session designed to bring together representatives of industries, municipalities, regulatory agencies and other engineers for the purpose of delineating their respective views and obligations in the matter of "Clean Streams in Our Southern Economy." The conference was jointly sponsored by Duke University, the University of North Carolina and North Carolina State College. The states of North and South Carolina, Virginia, West Virginia, Georgia, and Tennessee, actively participated in the meeting.

For this report, which highlights the Third Southern Municipal and Industrial Waste Conference, we are indebted to Prof. Nelson Nemerow, Assistant Professor of Civil Engineering, N.C. State College, who served as General Chairman of the Conference.

Fuhrman Keynoter

The keynote speech on the opening day was given by RALPH E. FUHRMAN, Deputy Director of Sanitary Engineering for the Government of District of Columbia, Washington, D.C. He talked upon the subject of "OUR DWINDLING CLEAN WATER SUPPLY AND ITS EFFECT UPON MUNICIPAL AND INDUSTRIAL EXPANSION." He brought out several important facts as follows: 15 hundred tons of fresh water are needed per year to maintain the average man in the United States; 17 western states are already using about 70% of all the water they can be expected to develop at a reasonable rate; that in 1975 the U.S. may be using as much as 90% of all water that can be developed at realistic costs; irrigation returns only about ⅓ of its volume to streams or ground water strata while the remainder is lost through evaporation and transpiration; the great increase in water demand in the next 20 years is expected to come from cooling water requirements of the electrical generating stations; that so far in the 20th century the withdrawal of water in the U.S. has about doubled on an average every 25 years; and that the availability of water has undoubtedly played a vital part in the South's industrial growth which reached the astounding rate of one new multi-million dollar plant during each working day of 1951.

Enslow Luncheon Speaker

LINN ENSLOW, Vice President and Editor of *Water and Sewage Works*, addressed the Conference at the luncheon on the subject of "WASTE TREATMENT—HOW ARE WE DOING AND WHERE ARE WE HEADING?"

Mr. Enslow reviewed progress made in industrial pollution abatement, a major share of the credit going to Industry for its attitude and cooperation which had come about through a decision within Industry to put waste reduction and treatment on a non-competitive basis. Thus, free discussion within such groups as the Manufacturer's Chemists Assn. and participation in conferences such as that held at Purdue University annually, and the Federation of Sewage and Industrial Wastes Association, plus open publication of research and development in waste curtailment, had contributed indispensably to progress in pollution abatement.

Another aspect of waste treatment had been the public relations aspect, many industries in the consumer products market having invited publicity on their contribution to cleaner streams. Without all of this, progress would have been far less in such a relatively short period.

As to "Where Are We Going?", Mr. Enslow said that much depended on the methods employed by control agencies in the future. First consideration should be a realistic approach and evaluation of pollution tolerance. Our yardsticks and standards will have to be revised in many respects and the pages of dogma applicable in sanitary engineering should for the most part be torn from the book.

In respect to "standards" the only realistic standard will always ultimately be the stream standard in conjunction with effluent standards confined to maximum (not more than) permissives rather than averages. Standards based on parts per million has no real significance, since it is only qualitative and not quantitative. Permissive loadings must be in pounds per 24 hours to be really meaningful.

It must be learned that the time to

Conference Operating Committee

For the Univ. N. C.	For Duke Univ.	For N. C. State Col.
Marvin L. Granstrom (2)	J. Wesley Williams (4)	Richard Bright (1)
Emil T. Chanlett (6)	Wade G. Brown (7)	Chas. Smallwood, Jr. (5)
Dan. A. Okun (8)	Paul C. Stottlemeyer (3)	Nelson L. Nemerow (9)

[On extreme right is Chairman Nemerow (9). Numerals indicate positions at the table, starting with member nearest camera as (1) and progressing to left around the table.]

stop pollution is before it starts. Internal process changes or equipment changes made in existing plants is the proper place to effect pollution abatement most economically. In new plants processes should be designed and regulated in accord with requirements dictated by stream conditions. Economics dictate reducing pollution to a practical minimum through process modifications as step number one. Thereafter the irreducible minimum of pollution at the source can be treated for further reduction or delivered to a municipal treatment plant where practicable to do so.

As to waste treatment, studies with pilot plants seem the only sound procedure and effect marked savings in ultimate plant design and process perfection. The saddest thing that could happen to the nationwide program will be too much hurry in building waste treatment plants that will not effectively or economically do the job. If this happens to any marked extent Industry is certain to rebel and call for riddance of impractical regulations and regulators.

Economic aid to industry for pollution abatement purposes should take the form of permissive accelerated depreciation for tax purposes such as exists in Wisconsin and is now being considered by the Federal government.

More Research a Real Need

The General Session in the afternoon of the 18th was devoted entirely to research. Professor MARVIN L. GRANSTROM discussed the "ROLE OF UNIVERSITY RESEARCH IN THE STUDY OF CHEMISTRY." He presented some of the difficulties involved in studying the internal conversion of monochloroamine to dichloroamine when chlorine and ammonia are mixed together for sterilizing purposes. DR. HEUKELEKIAN of Rutgers Univ. and Chairman of Research for the Federation of Sewage and Ind. Wastes Assns., presented a spirited, factual, and interesting discussion of the "TRENDS AND NEEDS IN WASTE TREATMENT." He proclaimed that the field of environmental health has not received an appropriate share of U.S.P.H.S. research grant funds. This does not mean that agencies have discriminated against us, but it does indicate that there is a lack of information and

PACKED ROOM, typical of sessions. Linn Enslow, luncheon speaker, stresses value of less haste, greater attention to process change, more pilot plant study and tax relief in non-profit industrial pollution abatement program. Chanlett, the session chairman, in back field.

AT HOME at his *Alma Mater*, from Cyanamid's Hedgepeth words of wisdom from the mouth of experience. Session chairman (left) is Don. Okun. PANEL ON RESEARCH (right) with G.E.'s Ken. Watson speaking and Wade Brown presiding. Panel participants seated are Prof. Smallwood, Dr. Hukelekian and Prof. Granstrom.

interest, or lack of worthy projects and moneys. Most college graduates have little idea of the vast opportunities available for research in the sanitary field for which their specialized training would be invaluable. Dr. Heukelekian described the progress that the Research Committee of the Sewage Works Federation is making to gather information as to the needs and facilities and to catalyze and facilitate the inception of research work. He concluded that what is needed is adequately trained personnel devoting most of their time to basic research.

KENNETH WATSON of General Electric Co. spoke about "RESEARCH IN INDUSTRIAL POLLUTION CONTROL" and informed the group that at least 405 projects are currently under way with a total annual expenditure in excess of 3 million dollars. He suggested that the basic industrial waste research approach for wastes, on which a proven workable answer is not yet available, should consist of 3 fundamental steps: (1) define the problem (2) apply conventional research techniques to determine which offers most promise and (3) apply the most promising technique on a pilot plant scale.

Professor CHARLES SMALLWOOD described "RESEARCH IN ACTIVATED SLUDGE TREATMENT" with particular study of the ion exchange capacity of the sludge. He said that both ion exchange and simple absorption are of importance in activated sludge process. An interesting observation was that large salt concentrations actually improved the settling properties of the sludge possibly through the ability of salts to destabilize colloidal suspensions.

Cone Dinner Speaker

MR. BEN CONE, Chairman of the Board of Directors of the Cone Mills Corporation, Greensboro, N.C., one of the South's leading textile organizations, addressed the banquet audience on the subject of "INDUSTRY LOOKS AT THE STREAM SANITATION PROBLEM." He posed the problem with which most states are faced· that of wanting new industries (and many of them) but not wanting any of the unpleasantness which goes with them, such as stream and air pollution. He asserted that waste disposal is not a local, but a state-wide problem, but that the power to "police" is the power to destroy. He feels that it will not be long before the "police power" we are giving our state pollution control agencies will be followed by state aid, mainly financial.

L. L. HEDGEPETH of American Cyanamid Co. opened up the second day of the conference by discussing "THE CYCLE OF INCREASING PRODUCTION *and* WASTE AND ITS EFFECT UPON INDUSTRY." According to his thinking, pollution abatement should be based not on how much a stream will tolerate, but what is the minimum of contamination that must be discharged by the polluter as the practical irreducible quantity. To reach this objective called for scientific ingenuity in rearranging processes, re-design of equipment within the plant. Then only the *must* discharges need be expensively treated if further reduction of certain components is required.

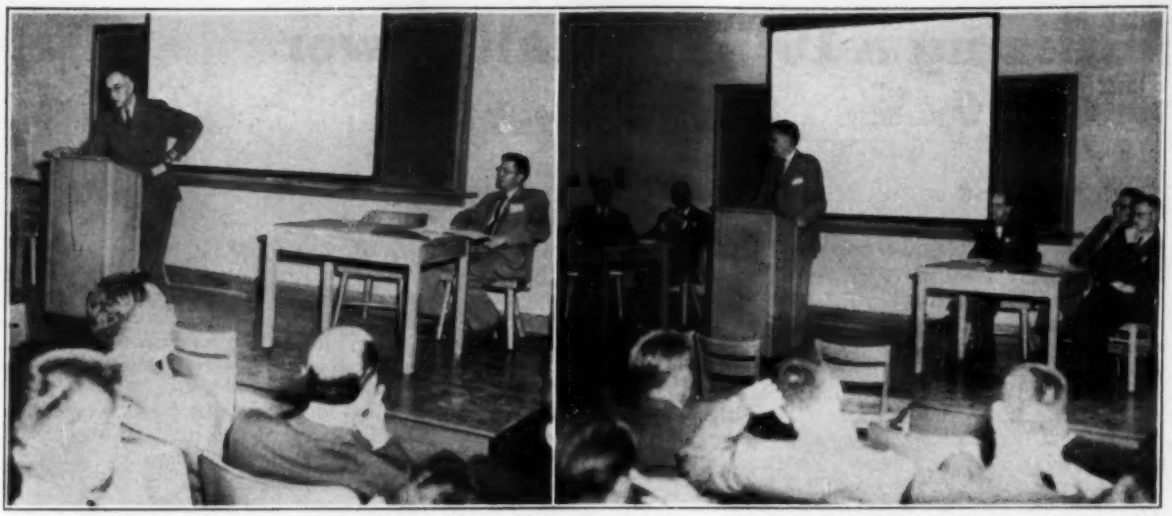
If pollution control authorities are to hold the respect of industry they must have sufficient information to make a sound case and not rely on wishful thinking nor too many of the yard-sticks of sanitary (public health) engineering. Far more can be accomplished if dogma of the sanitary field is put in moth balls and a truly realistic approach is made. The control authority is frequently led up blind alleys by assuming that top management must be reached directly. Formerly a state pollution abatement official, Mr. Hedgepeth again repeated his "stop — look — listen" advice to stream control engineers not to labor under the impression that yesterday's dogma in municipal pollution abatement fits the industrial pollution problem.

Four Simultaneous Sessions

Four simultaneous two-hour sessions were devoted to municipal, textile, and paper wastes, and to engineering design of treatment facilities.

The municipal session featured the moderation of GEORGE FRANKLIN, General Counselor for the North Carolina League of Municipalities. He spoke on the "Protection of Municipal Investments in Waste Treatment Plants by Ordinances. REECE C. SNYDER, City Manager of Marion, N.C., described "Industry's Participation in Marion's Sewage Treatment Plant. Colonel S. C. MACINTYRE, City Manager of Salisbury, N.C., described "Industry's Participation in the Salisbury Sewage Treatment Plant."

The Pulp and Paper Session was moderated by PROF. C. E. LIBBY, Head of the Pulp and Paper Department of the Forestry School at North Carolina State College. J. E. COPENHAVER, Chief Chemist of Sonoco Products Company, Hartsville, S.C., spoke on "Some Problems in Stream



COMMON LAW relating to water usages, being reviewed by Prof. Bolich (Duke Law School), with Nemerow presiding. LEGAL ASPECTS of pollution being launched by panel moderator City Mgr. Townsend. Panel members are Prof. Bolich; City Mgr. Jones; Legal Expert Geuther; Wieters of the USPH, and Virginia's Gibson.

Improvement at Sonoco Products Company."

A. L. WILEY, the Technical Director of Riegel Carolina Corporation, Acme, N.C., described "Stream Sanitation Control at Riegel Carolina." Robert Opferkuch, Director, and Herbert Berger, Field Engineer at the National Council for Stream Improvement Project at Virginia Polytechnic Institute, presented an interesting technical paper on "Anaerobic Digestion of Spent Semi-Chemical Pulping Liquor." They concluded that straight digestion under present operating conditions is economically impractical. Apparently this is due to the inhibiting effect of cumulative sulfides in the sludge. G. N. MCDERMOTT, of the U.S.P.H.S. in Cincinnati, Ohio, discussed the "Sources of Wastes From Kraft Pulping and Theoretical Possibilities of Re-use of Condensities."

The Textile Session was moderated by WALTER GARDNER, Water and Wastes Engineer of Fieldcrest Mills, Spray, N.C. Prof. PERCIVAL THEEL, Chairman of American Association of Textile Chemists and Colorists Committee on Stream Pollution of the Philadelphia Textile Institute, discussed the results of his group's activities. The country has been divided into 9 sections, each with his own assignment. W. R. STEEL, Manager of the Textile Section of the Solvay Process Co., of Syracuse, N.Y., talked on "Stream Pollution by Cotton Bleachery Wastes." Highlighting his talk were discussions of caustic recovery and the use of flue gas for caustic neutralization. N. S. CHAMBERLIN, Sanitary Chemist, Wallace and Tiernan Co., presented a paper entitled, "Application of Chlorine in the Treatment of Textile Wastes."

The Engineering Design Session, primarily for consulting engineers, was moderated by P. D. DAVIS, partner in Piatt and Davis firm in Durham, N.C. The Session was devoted to modern Sewage Waste Treatment Unit Designs. Discussion leaders were GEORGE RAWLINS, Vice President of the J. N. Pease & Co., Charlotte, N.C., and S. I. ZACK, of the Gannett, Fleming, Corddry, and Carpenter Consulting Engineering firm. of Harrisburg, Pa. Mr. Rawlins talked mainly on equalization basins and accelerated sludge digestion. Mr. Zack concentrated his remarks upon secondary treatment of sewage and industrial wastes.

Legal Aspects of Pollution

The afternoon Session was a General Session on the "Legal Aspects of Stream Pollution." Prof. W. BRYAN BOLICH of the Duke Univ. Law School, Durham, N.C., set the stage for a panel discussion by presenting a summary of "Common Law Relating to Water Usages."

The panel discussion was masterfully moderated by Brigadier General J. R. TOWNSEND, present City Manager of Greensboro, N.C. One panel participant was C. V. JONES, Attorney, of City of Durham, N.C., who presented "Municipal Rights and Obligations." He concluded that the courts should take a more realistic view of the present day engineering and financial problems involved in the operation of a municipal sewage treatment plant handling industrial wastes; that up-to-date modern techniques be developed; and that affected land owners should cooperate with the city rather than look upon them as some foreign power bent on wreaking destruction upon everyone involved.

ALBERT H. WIETERS, Assistant Chief of the Division of Water Pollution Control of the U. S. Public Health Service, Washington, D.C., presented the "Technical Aspects of Stream Pollution." He stated that while there are many technical problems involved and much research left to be done, correction of existing pollution and prevention of degradation of waters can not await the final answers to all of the technical problems.

CARL E. GEUTHER, Legal Expert, of the E. I. Dupont Company of Wilmington, Del., spoke of the "Industrial Concept of the Pollution Problem." The main point of his spirited talk was that industry should consider a stream pollution abatement program as a means of industrial survival rather than a protection of the river for recreation, health, or fish.

FRANK GIBSON, of the Bureau of Public Administration, University of Virginia, enlightened the group with an encouraging report on the "State and Federal Aspects of Water Pollution." He maintained that if we clean up our own back yards, there is no reason to fear rigid, inflexible state laws or stronger Federal legislation. If stringent Federal legislation does come, however, we have no one to blame but ourselves.

The Fourth Southern Municipal and Industrial Waste Conference will be held in the Spring of 1955 at Duke University.

Utilizing a 1908 Outfall Sewer

Old sewer at Waterbury, Conn., functions efficiently in the city's new sewage treatment plant

by WILLIAM S. WISE, *Director, State Water Com., Hartford, Conn.*

THE 45-year service record of a reinforced concrete sewer has been revealed graphically to the city fathers of Waterbury, Conn., in terms they can both appreciate and enjoy—dollars and cents. Completed in 1908, this main carrier sewer was utilized in the construction of Waterbury's new $1,000,000 sewage treatment plant. Today, this old-timer is just as efficiently functioning as plant inlet, outfall and bypass as it did as an outfall sewer almost a half century previously—a real tribute to the concrete of which it was built and the care used in its design and construction.

Design and Construction

The horseshoe-shaped reinforced concrete main sewer was originally laid on a grade of 1 ft. per 1,000 ft., and has a capacity of 47,400,000 gal per day using 95 per cent of the cross-sectional area. The veteran outfall sewer handles the domestic waste and a part of the industrial wastes of a population of 105,000 people. The fact that the sewer has adequate capacity almost fifty years after it was built reflects credit on the engineering judgment of William Gavin Taylor, the design engineer who drew up the plans in 1906, and R. A. Cairns, the city engineer under whose direction its construction was accomplished.

The outfall sewer, having a length of over 3 miles, was originally designed to serve temporarily as a combined sewer, with conversion to a separate sewer contemplated after some years' service. For 1500 feet the sewer location ran through the bed of the Naugatuck River, where conditions favored the construction of a retaining wall for the reclamation of low-level lands lying adjacent to the right bank of the stream. For this section, the foundation slab was designed to serve both as the sewer invert and as a foundation for retaining wall, being widened some 8 feet for this purpose. The sewer was laid through water-bearing soil, much of it being 4 to 12 feet below the ground water table.

Today's Savings

Some idea of the savings to the city made possible by the durability and serviceability of the old reinforced concrete sewer may be obtained by a consideration of the cost of the sewer in 1908. According to cost records kept under several contracts by Mr. Taylor, the normal cost of the horseshoe-shaped sewer was $2.97 per linear foot or something more than $48,000 equivalent to $8.02 per cubic yard of concrete. If it had been necessary to replace this line when the Waterbury project was completed in late 1951, the cost probably might have been as much as $200,000 and possibly more.

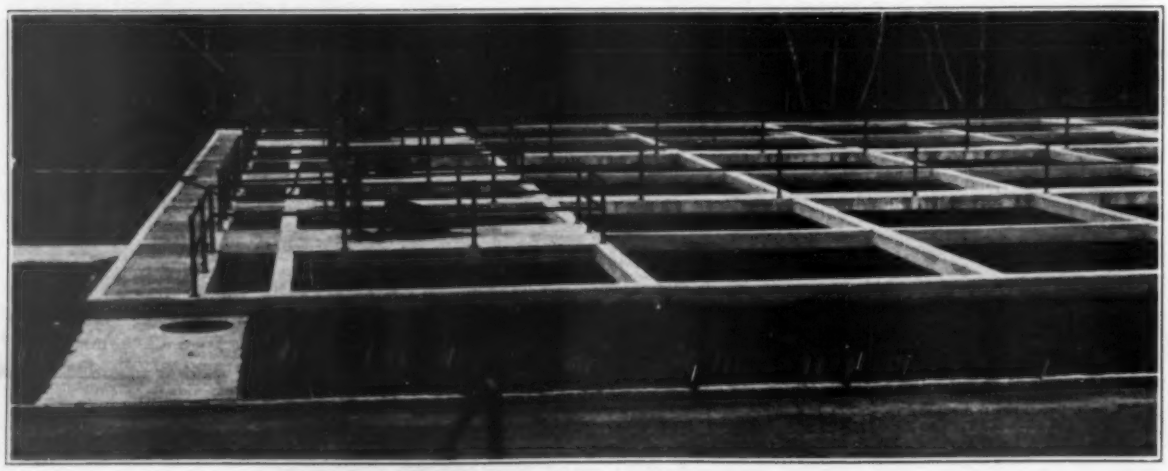
By not having to construct a new outfall sewer to the treatment works, the cost of the present project was reduced by 20 per cent or more, an appreciable saving to the taxpayers of Waterbury.

The old reinforced concrete outfall has provided an economical collector for the sewage and industrial wastes of this important industrial city for many years. If it had been built with less durable materials, it could not have contributed its part in carrying out the pollution abatement program in the Naugatuck River Valley. Good planning and good construction pay good dividends.

State Program

The State of Connecticut has a program under way to control unwarranted pollution of all waterways in the State. This program is under the direction of the Connecticut State Water Commission. One of the parts of that program was a cleanup of the Naugatuck River, which meant treatment of the sewage and industrial wastes in Waterbury. Thus, this project was an important part of the over-all state water pollution control plan.

Waterbury's new sewage treatment plant was designed for an average flow of 15,000,000 mil gal and a maximum flow of 30,000,000 gal per day. Plant units include a plant inlet control structure, screen and grit chamber, sewage pump-room and administration building, three settling tanks, a 36-in. Parshall flume and recording gauges, chlorine building, sludge storage building, and sludge filter building. In this latter building the



SEDIMENTATION tanks at the Waterbury plant

OVER-ALL view of Waterbury, Conn. sewage treatment works

bulk of the equipment for pumping, conditioning, filtering and drying of sludge is housed.

The plant inlet control structure astride the horseshoe-shaped sewer diverts the flow to the plant through a 60-in. reinforced concrete pipe, and is so arranged that flows above 30,000,000 gal per day may partially bypass the treatment plant over a central baffle wall. Two sluice gates are installed for emergency bypassing the entire flow through the 45-year-old concrete sewer.

Strong Industrial Wastes

The 53-54-in. concrete interceptor sewer carries domestic sewage containing copper, chromium and considerable acidity. The pH fluctuates between 3.8 and 7.2 when the mills are working, according to information publised in *Sew. and Ind. Wastes*, Aug. 1951. Because the concentration of copper and chromium and low pH would interfere with sludge digestion processes, digestion of sludge could not be utilized. Instead, vacuum filtration issued for dewatering raw sludge from primary sedimentation tanks.

The new sewage plant was constructed in combination with the incinerator plant. This plan introduced considerable flexibility into the system, since heat from the incinerator may be used to flash dry the sludge cake from the vacuum filters. There are facilities for bagging the dried sludge for soil conditioning or for burning the sludge to an inert ash. During periods when not enough heat is available to dry the sludge, mechanical conveyors move the sludge cake to trucks for disposal at a nearby dumping ground.

The Waterbury Sewage Treatment Plant project was carried out by the City's Bureau of Engineering headed by Henry C. Whitlock, City Engineer, with Malcolm Pirnie Engineers of New York City as engineers of design and consultants on construction. Henry W. Taylor was associate consultant for designing the refuse incinerator, built in connection with the sewage treatment plant. F. H. McGraw and Co. of Hartford was contractor on the $1,000,000 sewage treatment plant, and was also successful bidder on a separate contract for the incinerator plant built at an approximate cost of $450,000. The plant is located about one-half mile above where the outfall sewer empties into the Naugatuck River.

Waterbury, located on the Naugatuck River in west central Connecticut, is known throughout the world as the "Brass City." Beginning with the establishment of the brass industry in Waterbury in the early 1700's, development has progressed to the point where more than 235 separate manufacturing establishments are located in the city. Principal industries now include brass and brass products, copper and copper products, clocks, watches, timing devices, and recording instruments. Collectively, these place quite a stress on the sewage system—but the 46 year old concrete sewer and its conpanion new sewage works are meeting the demands of this great industrial city.

GRIT chambers, part of the new construction

APPLYING chemical weed killer from 10-gal. power sprayer

Waukegan's Weed-Free Sludge Beds

Simple chemical treatment frees labor for more productive duties

by **L. A. CONN, *Tech. Representative, E. I. du Pont de Nemours & Co., Inc. Wilmington, Delaware***

WEEDS are sometimes defined as "plants in the wrong place"—and they can find a good many wrong places to get into around a sewage treatment works. They particularly like to deface the clean sand surface of sludge drying beds, when not in use, or tangle fence-rows and retaining walls where a power mower can't reach them. Railroad sidings and gravelled areas are also "fair game" for weeds.

Hand-grubbing and trimming are tedious and disagreeable, and present an increasingly difficult labor problem. Wages alone make this kind of hand-work an expensive luxury, aside from the fact that workmen object to long hours of toil in the hot sun.

Raymond E. Anderson, district chemist-engineer for the North Shore Sanitary District in Illinois, has been grappling with the weed problem ever since he first took over his job in the trim, yellow brick building outside Waukegan, nine years ago. He's watched the workmen invent tools of their own—one that looks like an ice-scraper or lawn-edger; and another that is simply a power saw blade welded to a handle. But Joseph Debevic, acting plant superintendent, says most of those tools "just transplant the weeds." One of the most troublesome is pepper grass, and another is smart weed.

Ed. Note. At the time that the Waukegan experimental work was conducted the product employed was known as CMU Weed Killer. We are advised that the material is now being marketed under the new name—"TELVAR-W."

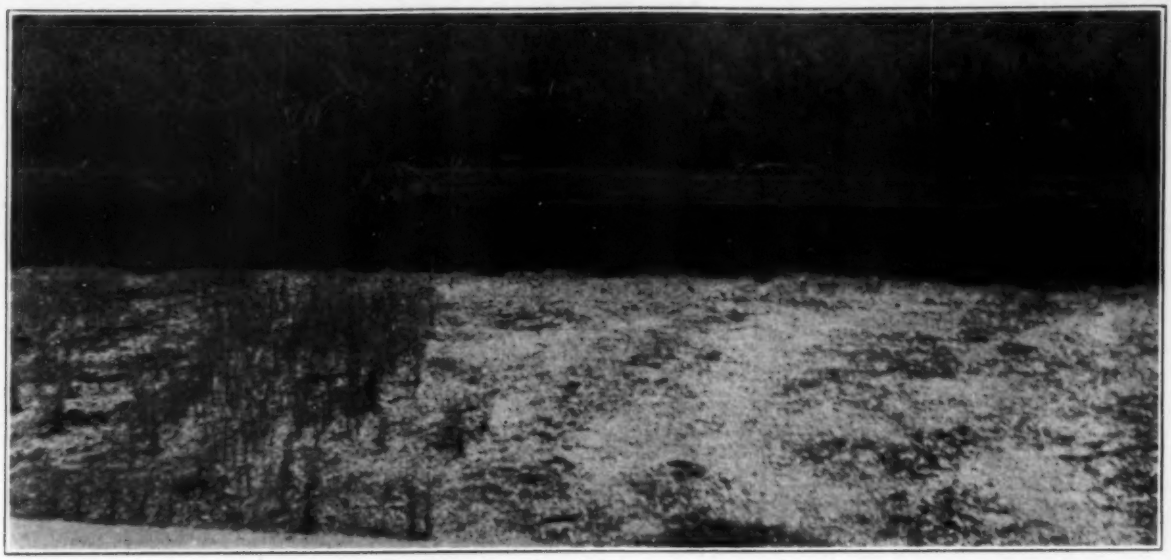
SIX-INCH swath along fence treated with weed killer eliminates hand clipping

Best Maintained Plant

Long hours of hoeing in the sludge-drying beds have just barely kept the weeds under control in the past—and the job was never finished all summer long. Even under this handicap, in 1951 the Waukegan plant won the Illinois State Health Department award for the best maintained plant in the state. This was a proud achievement for veteran plant superintendent Matt Kirn, now on leave of absence, and for his operators. And in September of 1952, when the State Association visited the plant, "the grounds never looked better" said Joe.

But something new had been added to their maintenance program before that state meeting—a chemical weed killer that cut about 85 per cent of the labor out of weed control during 1952, and was still keeping the sludge-drying beds clean nearly a year after application.

Any chemical used for weed control in the beds has to meet exacting requirements. Anything based on oil might collect so much dust it would



UNTREATED and treated areas of sludge bed

Results from application of 2 ounces of "Telvar-w" per 100 sq. ft. in Aug. 1952. Photo taken in June 1953

clog up the beds. Water-soluble compounds might wash right through at the first rain, without lingering long enough to do the job. Chemicals used in large quantities might affect the functions of the bed itself.

What's needed is a long-lasting compound, effective in small quantities, that won't interfere with the normal processes or work programs of the plant.

Ray Anderson thought he saw hope in a clipping about "CMU" Weed Killer* which came across his desk early in 1952. He obtained just two pounds of the material in March, and arranged for test applications in April, before weeds had come up in the drying beds.

The chemical comes as a wettable powder which forms a suspension in water. Selecting four plots, each 216 square feet, Ray tried four different concentrations—one, two, three, and four ounces per gallon per 100 square feet. No weeds came up in any of the plots—while in check areas alongside, the weeds were as plentiful as ever.

In June, another area was sprayed—this time 1,875 square feet. Ten ounces of the chemical in five gallons of water killed weeds that were already three to eight inches high, and the beds stayed clean all summer. This single application of 0.53 oz. of CMU powder* per 100 sq. ft. proved ample.

Trials Successful

With this trial experience, Anderson and Kirn went to John S. Whyte, president of the five-man board of trustees, told their story and invited Mr. Whyte to see for himself.

As a result, the North Shore Sanitary District purchased enough CMU Weed Killer* to treat all the drying beds at the Waukegan plant. A wheelbarrow model power sprayer to apply it was also purchased. One of the laboratory assistants weighed out 66 pounds in 15-ounce portions in paper bags to speed the refill operation, and then at the rate of 15 oz. per 1000 sq. ft., they sprayed a total of 70,000 square feet, or 1.6 acres. They also sprayed some along the fence-lines and retaining walls to kill the weeds and grass so a power-mower could do virtually all the lawn-clipping.

Raymond E. Anderson, chemist-engr., and Joseph Debevic, acting plant supt., examine weeds from sludge beds of their plant.

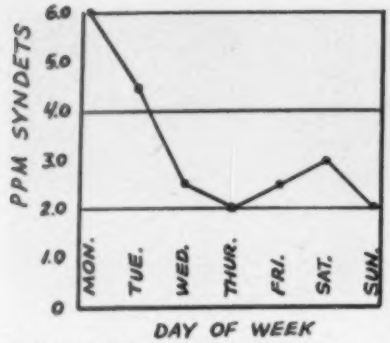
A three-gallon hand-sprayer was used in the original test work, but the 10-gallon wheelbarrow model sprayer was used for the larger applications. This sprayer has an agitator, which is essential to keep the powder suspended in the spray tank. A hose delivering water right to the job and the 15 oz. bagged charges of the CMU* materially speeded up the work.

The Waukegan plant is the largest of 11 plants in the North Shore Sanitary District, which runs along Lake Michigan from Highland Park, Illinois, to the Wisconsin state line. Louis K. Ekstrand is superintendent of the plants outside of Waukegan. With the success achieved in Waukegan, the trustees of the Sanitary District feel optimistic about holding their own in maintenance contests from now on. CMU (now known as "Telvar-a") has proved to be the workmen's "best friend"—no more weeding in the hot summer sun. In addition it poses no safety problems, such as toxicity to the users, damage to clothing, nose and skin irritation, or fire hazard.

CAL Engineers formed by Two Consultants

Roy E. Coble and Russell G. Ludwig and Associates have announced the merger of their companies to form CAL Engineers.

The new Elmonte, California, firm will offer service as consultants in the field of sanitary engineering, including water supply and distribution, and water analyses.



VARIATION of syndets during a week

More Data on Syndets in Municipal Sewage

A report on studies made at Hagerstown, Md.

by DON K. CROFT, Project Engr., Baker-Wibberly, Inc., Cons. Engr., and SAMUEL D. FAUST, Chemist, W. A. Taylor & Co., Baltimore, Md.

A SYMPOSIUM held under the auspices of the Amer. Chem. Soc. Division of Water, Sewage and Sanitation Chemistry reviewed and evaluated reports of the detergent effect on sewage and water treatment.[4] The symposium concluded that there are wide variations of opinion as to the practical effect of syndets in sewage, but whatever problems do exist, certainly are not of a temporary nature.

Another symposium on the subject was held by the Fed. Sew. & Ind. Was. Assns. at its 25th meeting in New York City in Oct. 1952.[5] Water treatment plants may soon be affected by detergents in raw water. Culp and Stoltenberg[6] presented a paper describing the difficulties encountered in treating water at Osawatomie, Kans. Surfactant use is on the increase and will no doubt continue to increase. England has contributed largely to our present day knowledge of the subject. Hurley's statement[7] that little thought is needed to make clear the fact that the investigation of the whole problem of treating detergents at the sewage works would need an immense amount of research work. The same is true of sewage treatment plants here in America.

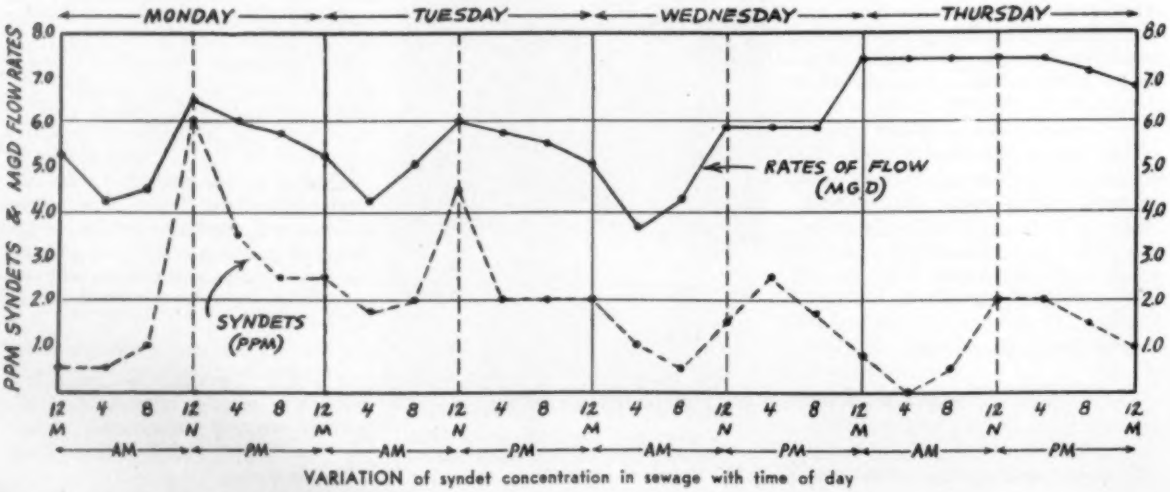
In the ACS symposium, no apparent mention was made of sewage analyses that would shed any light as to the actual detergent content. Data, collected on the problem, were obtained by adding known amounts of the compounds to influents and effluents. Keefer[1] was one of the first investigators to provide information on concentration and removal of this new constituent in sewage stating that, "one of the reasons for the lack of information on the subject of syndets in sewage is, that many of the laboratories at sewage treatment plants are not equipped to determine the detergent content of sewage." This observation led to an investigation for a simple, reasonably accurate colorimetric method for the determination of these compounds, one that a sewage plant operator can manipulate.[8]

Present Research

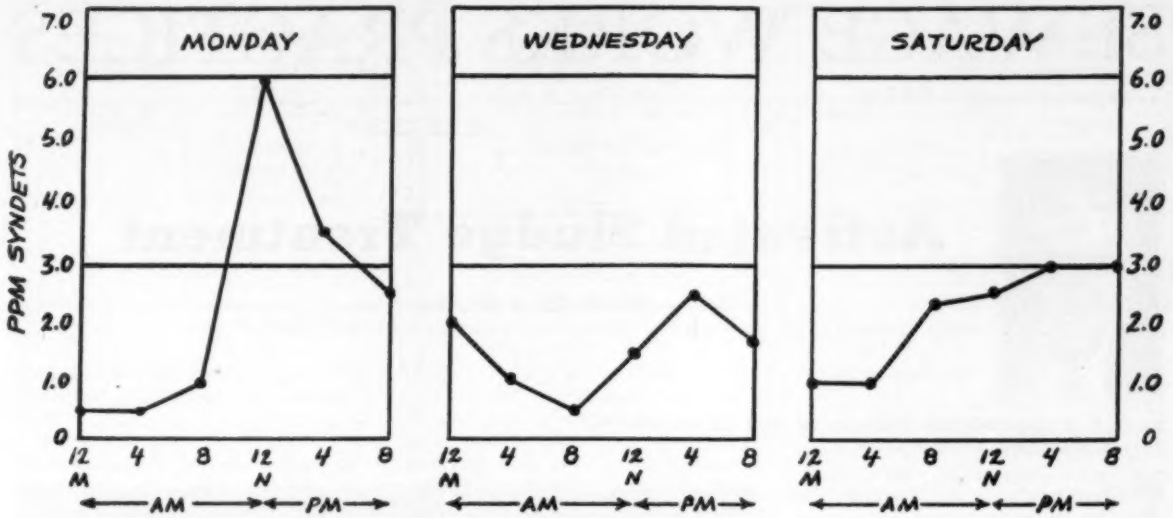
In cooperation with W. A. Taylor & Co., and using the method reported[8], personnel at Hagerstown's Sewage Disposal Plant conducted the research reported here. Extending over a seven-day period from December 8, 1952 to December 14, 1952, samples of raw and treated sewage were collected every four hours. The hour and rate of flow were recorded simultaneously. The object of this work was to correlate and evaluate information relative to the detergent content day by day, hour to hour, during any given day and rate of flow.

In order to appreciate this information, it is necessary to use the graph method in recording the data. Figure 1 shows the detergent content in parts per million plotted against days of the week, while Fig. 2 plots the detergent content in parts per million against sampling hours on three different days. Figure 3 shows a graph of rate of flow and concentration of syndets plotted against time for a four-day running period.

In Fig. 1 the maximum "syndet" concentration for each day is shown. The high for the week was 6 ppm which passed through the plant on Monday. This is attributed to "wash day." The low concentration occurred on both Thursday and Sunday. After Thursday, the concentration rose on Friday and Saturday (3.0 ppm) then



VARIATION of syndet concentration in sewage with time of day



VARIATION of flow and syndet concentration with time of day

dropped again on Sunday. This type of graph can provide helpful information for the plant operator. If necessary, special treatment can be applied to combat any damaging effect on sewage digestion processes.

Figure 2 shows the study made every four hours throughout the day on Mon., Wed. and Sat. On Monday when the highest concentration (6.0 ppm) was observed, the "syndet" concentration remained below 1.0 ppm from midnight to 8 a.m. From 8 a.m. to noon a big rise in the curve is noticed with the reading of 6 ppm at noon, as the high for the day. Wednesday's curve decreased from midnight to 8 a.m., then rose to a 2.5 ppm peak late in the afternoon. Saturday deviated from the patterns of other days, beginning low at midnight and 4 a.m. and rising through the day to a peak of 3.0 ppm at 4 and 8 p.m. Generally the highest concentrations were found from noon to 4 p.m. during any given day.

In Fig. 3, the syndet concentration and rate of flow are both plotted against time for four days. The upper curve is the rate of flow in million gallons daily, and the lower curve is the detergent concentration in ppm. The two curves follow a general rising and falling at the same time. The flow data, however, on Wednesday through Sunday were complicated by rainfall. For that reason, it would be unwise to designate a certain flow and attach a definite syndet concentration to it.

Removals

Data were also collected on syndet concentration in the effluent from the primary tanks and from the final effluent. These data are shown in Tables 1A and 1B. Data in Table 1A were collected across the plant at the same hour. Some retention or removal of the detergent by the solids is apparent, but the data in Table 1A actually represents three different samples examined. The samples collected for Table 1B allowed for detention time of the treatment processes and represent more accurate results. These data also show retention or removal of the detergent.

In order to determine whether or not any detergent is actually being removed by the solids, a test was made on an effluent from an aeration unit. As sampled, a reading of 3.0 ppm "syndet" was recorded. The solids were allowed to settle. Examination of the supernatant liquid gave a reading of 2.00 ppm. Again there is evidence of detergent removal.

The Future

Since the domestic and industrial use of the surface active compound is increasing each year, it may be wise for the sewage plant operator to consider all possible situations. The biggest problem lies in the excessive use of the detergent by the public.

Another possible variable, not taken into consideration, is the season of the year. We can safely assume in the spring, summer, and fall months there will be an increase in consumption of "syndets." Larger laundry loads, and more car washings are among the contributing factors.

The writers hope that this paper has contributed in some small way to knowledge of this increasing treatment problem. Hagerstown's data are assumed to be typical of other cities and communities.

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3. Faust, S. D., "Colormetric Determination of Anionic Synthetic Detergents in Sewage", *Water and Sewage Works*, 100, #8, pp. 242-3, June 1953.
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5. Finch, John, "The Detergent Situation in England", *Water and Sewage Works*, 100, #8, pp. 239-241, June 1953.
6. Culp and Stoltenberg, "Synthetic-Detergent Pollution in Kansas", *Journal AWWA*, 45, #11, Nov. 1953, pp. 1187.

Table 1

REMOVAL OF SYNDETS IN SEWAGE TREATED

A—SAMPLES COLLECTED AT SAME HOUR

Day	Raw Sewage	Settling Tank Effluent	Trickling Filter Effluent
	Concentration of Syndets in ppm.		
Friday noon	2.0	1.0	0.5
Monday noon (12-2-52)	5.5	3.0	1.0
Mondal a. m. (12-8-52)	1.0	0.5	1.0
Tuesday noon	4.5	1.75	1.0
Wednesday p. m.	2.5	2.0	1.5
Thursday p. m.	1.5	1.0	1.0
Friday Midnight	1.0	1.5	1.0
Sunday a. m.	0.5	0.25	0.0
B—Samples Collected Allowing for Detention Time			
Tuesday	2.75	2.5	1.5
Wednesday	3.0	2.5	2.0

SEWAGE WORKS PRACTICES

Activated Sludge Treatment

Ninth in a Series

by **DON E. BLOODGOOD,** ***Professor of Sanitary Engineering, Purdue University, Lafayette, Ind.***

THE importance of bacteria and other microorganisms in sewage treatment has previously been emphasized in this series of articles. The activated sludge process is a biologic process and, accordingly, is dependent for its success upon the "good" bacteria that thrive in the system.

An extended court action in the United States resulted in the decision that the process was an invention by Arden and Locket in England in 1914. The main contestants in this country were the Sanitary District of Chicago and the Milwaukee Sewerage Commission; it is the belief of many individuals that the court decisions were based more largely on personality differences than on the scientific facts in the case.

The activated sludge process has been considered especially advantageous (a), when a very high quality of effluent is required, and (b) when the area available for a sewage plant location is relatively small. The severest criticisms of the process have been based on the claim that the process was too easily upset and that it cost too much to operate. Changes in relative prices for land, labor, power and equipment seem to bring about alternating waves of praise and criticism of the process. At the present time, activated sludge plants are being approved by water pollution control agencies in states where a few years ago the activated sludge process was in disfavor and was not considered a suitable method of treatment. As time passes, it is certain that many new ideas will be developed and applied in activated sludge operation. Some of these will result in improvements in the process and others will soon be forgotten.

The Process Described

It is much easier to talk and write about the activated sludge treatment of sewage, believing that it has been adequately described, than it is to provide definition of it. The activated sludge process may be described as the controlled application of bacteria and other microorganisms which are cultivated, accumulated, and supplied with sewage as food. The activated sludge so developed can utilize both suspended and dissolved organic solids as food.

N.Y. City Dept. of Public Works Photo

Fig. 1—ACTIVATED SLUDGE under the microscope
Typical appearance of zoogleal masses and stalked ciliates

The bacteria comprising activated sludge are found in nature, in ground water and in sewage (see Fig. 1). There are many different types of these helpful bacteria; various researchers have reported as many as fifty different types. Not all these microorganisms are found in the same activated sludge plant, nor is it necessary that they should all be present. There is much similarity between these microorganisms and one kind can feed on the sewage as well as another.

This discussion of the bacteria in activated sludge is not intended to give the impression that activated sludge is a pure culture of bacteria. The treatment of sewage by activated sludge might be considered to be somewhat like a feeding pen for a herd of beef cattle, where a great number of cattle would correspond to the bacteria just described; there would also be a few hogs, picking up both spilled food and useable parts of the cattle manure. These would represent another type of microorganism. Then there are other types of organisms in the activated sludge that might be likened to chickens, rats and mice in the cattle feeding pen. The animals present use the grain provided as their

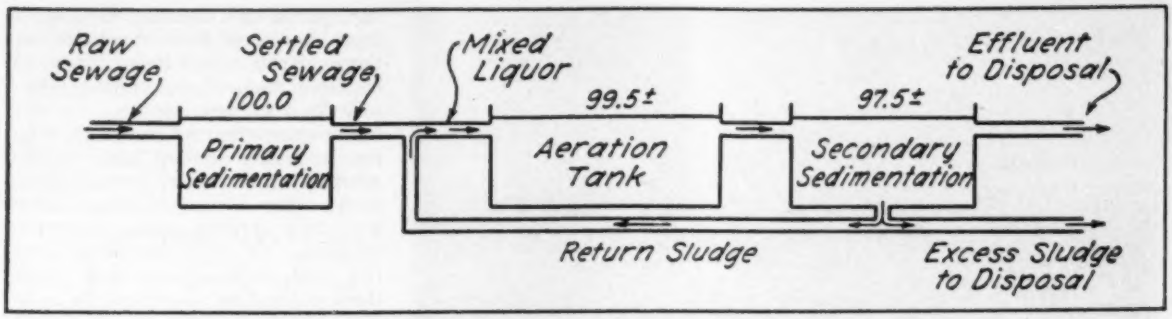


Fig. 2—FLOW DIAGRAM illustrating units required in the activated sludge treatment process

food, the bacteria in a biologic sewage treatment process use the sewage as food.

There are other ways in which the activated sludge process is quite similar to cattle in a feeding pen, and these similarities will be pointed out in the following discussion.

Oxygen is Essential

Activated sludge requires oxygen, because the bacteria and other microorganisms involved are *aerobic* and must have air for their life processes. It is believed that the bacteria cannot take oxygen directly from the air, but that the oxygen must first be dissolved in water or sewage. By comparison, if a stock pen were tightly closed in except for a few cracks, the cattle would soon die for want of oxygen. It is the same with bacteria contained in activated sludge. It can be concluded that an adequate supply of air is absolutely essential for the operation of an activated sludge treatment process. It seems reasonable to believe that an overabundance of air will not harm activated sludge, any more than it would harm the herd of cattle to let them out onto a range where there was more air than the minimum the cattle needed.

Plant Units Required

An activated sludge plant generally consists of a primary treatment plant to which an aeration tank and final settling tank have been added. It may also be considered as similar to a trickling filter plant in which the trickling filter is replaced by an aeration tank. A flow diagram for a typical activated sludge plant is shown in Fig. 2 and operating units are illustrated in Figs. 3 and 5.

In the trickling filter, microorganisms and sewage solids are held on the stones of the filter, while in the activated sludge process the solids and accompanying bacteria are kept in suspension in the aeration tank. The activated sludge subsequently is separated in the secondary settling tank, and a portion of it is returned to the head end of the aeration tank to be mixed with incoming sewage.

It seems likely that the quantity of sewage solids in activated sludge exceeds that of active bacteria. The accumulated solids retained in an activated sludge system usually amount in weight to four to ten times the weight of solids removed per day by the activated sludge process.

An activated sludge plant cannot be placed in full operation in a matter of a few days. The development of a suitable and satisfactory sludge requires a period of time that may run into several weeks, depending upon the temperature of the sewage and the characteristics of the sewage, such as the amount of food available.

Aeration Methods

The liquid in the aeration tank of an activated sludge treatment plant is termed mixed liquor because it is made up of a mixture of sewage and of sludge returned from the secondary settling tank. The mixed liquor must be supplied with oxygen by continuous aeration. There are two general classifications of methods for aeration: the diffused air and mechanical aeration methods.

In the diffused air method, the air is compressed and then discharged into the mixed liquor, using some method of breaking the air up into small bubbles (see Fig. 4). In the mechanical aeration method, the atmospheric air is beaten or whipped into the mixed liquor by propellers, brushes, or pumps; by such action, thin sheets or drops of the mixed liquor are exposed to the air (see Fig. 6).

The growth and activity of bacteria and other microorganisms are influenced by temperature. The activity of activated sludge organisms increases with rising temperature, up to about 105° F. Temperatures above 105° F. will kill the microorganisms in activated sludge. High temperatures seldom cause difficulties in activated sludge plant operation. Low temperatures, such as those experienced in very cold weather definitely decrease

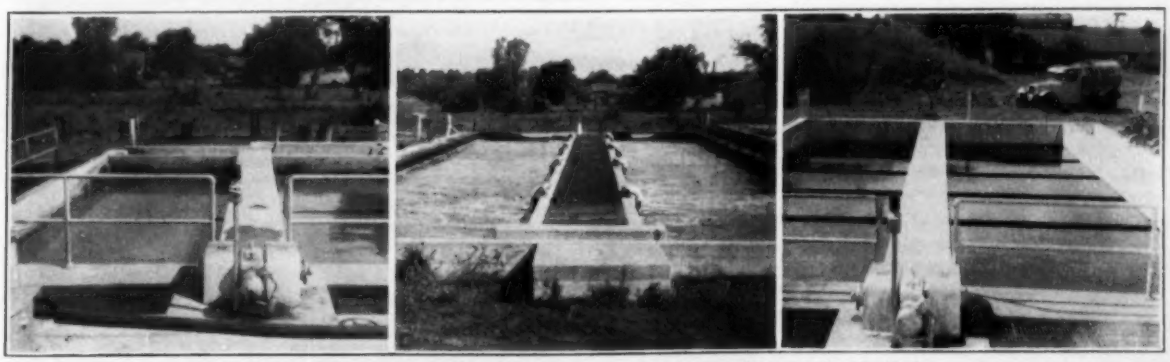
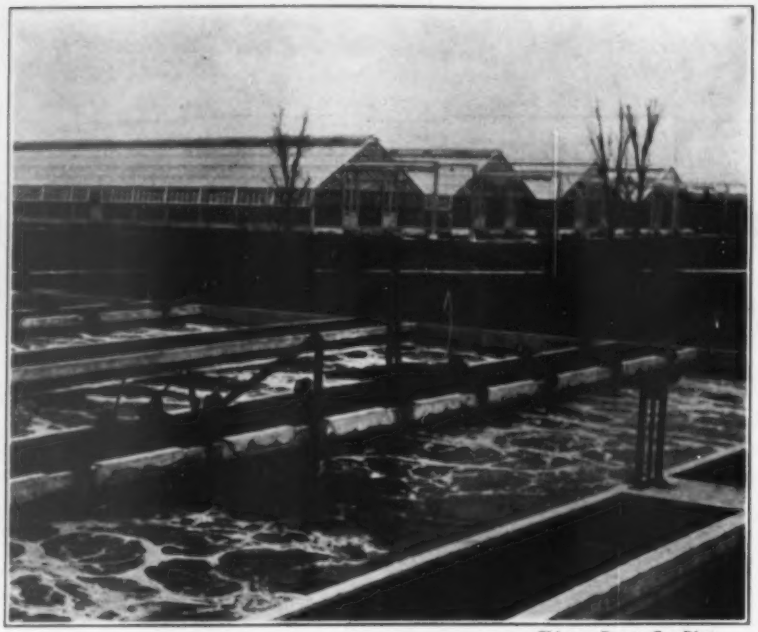


Fig. 3—OPERATING UNITS in a small activated sludge plant, Noblesville, Ind.
Left—Primary tanks, capacity 60,200 gal., retention time 1.8 hours. Center—Diffused air aerators, capacity 254,000 gal., retention time 6.1 hours. Right—Final clarifiers, capacity 95,200 gal., retention time 2.8 hours.



Chicago Pump Co. Photo

Fig. 4—OMAHA, NEB. Swing diffusers used at Papillon Creek plant
Design flow of this plant is 3.5 mgd.

the rate at which work can be done by activated sludge. As evidence of this, an activated sludge plant can be made to function in a much shorter period of time in the summer than in cold weather.

Starting Plant Operation

Starting an activated sludge plant in operation should be done in much the same way a stock feeder would balance his feeding of cattle on a supply-and-demand basis. Generally, he would plan to have a sufficient number of cattle to eat the food being delivered. If there were not enough cattle available, the stock feeder would not try to make the cattle eat more than they could conveniently digest, because if the cattle did so they would more than likely become ill. In an activated sludge plant, if there is not a sufficient number of organisms in the mixed liquor to consume the available food, then it is undesirable to crowd extra food (sewage solids) into the system. A slow increment of sewage solids over an extended period is the proper way to increase the bacterial population and the quantity of sewage which can be treated. The *sludge index* is the most useful test to apply in determining what is a satisfactory rate of increase of the sewage flow.

It is always necessary to provide an amount of air sufficient to maintain dissolved oxygen in all parts of the aeration tanks. One of the sure ways to cause difficulty in operating an activated sludge plant is to decrease the amount of air being used. Since the costs of producing compressed air and of mechanical aeration are high, there are economic reasons why care should be taken not to waste air. A sewage plant usually represents a large investment, however, and to operate it without sufficient air means the ineffective use of costly equipment.

When starting an activated sludge plant of the diffused air type, aeration should start as soon as the first sewage is admitted into the aeration tanks. While the *rate of filling* the aerator units is not important, as soon as the aerator unit is filled the *rate of flow* through the unit becomes very important. A sewage flow one-quarter of the final rate which it is planned to handle in an aerator is quite satisfactory for a starting rate.

The pumps that return sludge from the secondary settling tanks to the aeration units should be started as soon as there is enough sewage in the secondary settling tanks to permit pumping. This procedure returns settled solids to the aeration tank, where there is aeration to support bacterial life. As sewage enters the plant, bacteria develop solids from dissolved materials, the solids settle out, and there will be a gradual increase in solids in the system. The concentration of solids in the aeration tank liquor can be determined by laboratory tests. The concentration of solids will increase to a figure usually between 600 and 6000 ppm.

Solids in Mixed Liquor

The concentration of mixed liquor solids is an indication of the population of microorganisms present to consume sewage solids entering the plant. This means that where the mixed liquor solids are 2500 ppm, a plant can be expected to effectively treat a sewage having a higher B.O.D. than can a plant where the mixed liquor solids are 1250 ppm. An operator may say that he cannot maintain more than a specified concentration of mixed liquor solids in his plant. The probable reason is that the operator does not or cannot supply enough air to maintain a higher concentration, or that the operator does not allow for a slow increase of solids in the mixed liquor.

The bacteria responsible for consuming solids in the activated sludge sewage treatment process live in the sludge in jelly-like masses. The bac-

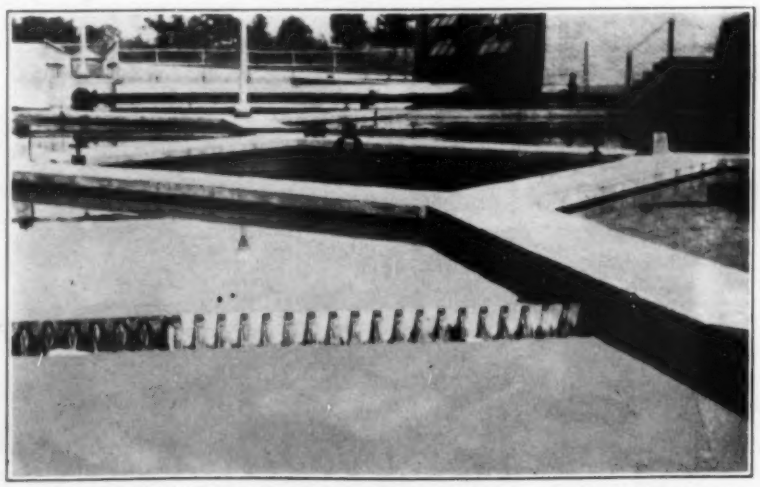


FIG. 5—INDIANAPOLIS, IND. Final settling tanks have radial weirs discharging at center

terial jelly seems to absorb both suspended and dissolved solids, in much the same manner that zeolite water softeners function. In rare instances, bacteria may leave the jelly-like masses if food becomes scarce; but probably very few operators ever have actually seen the results of such behavior.

Bacteria have been mentioned many times in this discussion, and it may appear that they are the only important organism in the activated sludge. However, within the sludge a multitude of other organisms maintain a balanced microscopic world. There have been reports that indicate the protozoa should be considered equal to or even more important than the bacteria; recent work has minimized the importance of protozoa in activated sludge. The protozoa can be seen quite easily by microscopic examination, and the presence or absence of certain types often can be used as an indication of good or bad activated sludge quality.

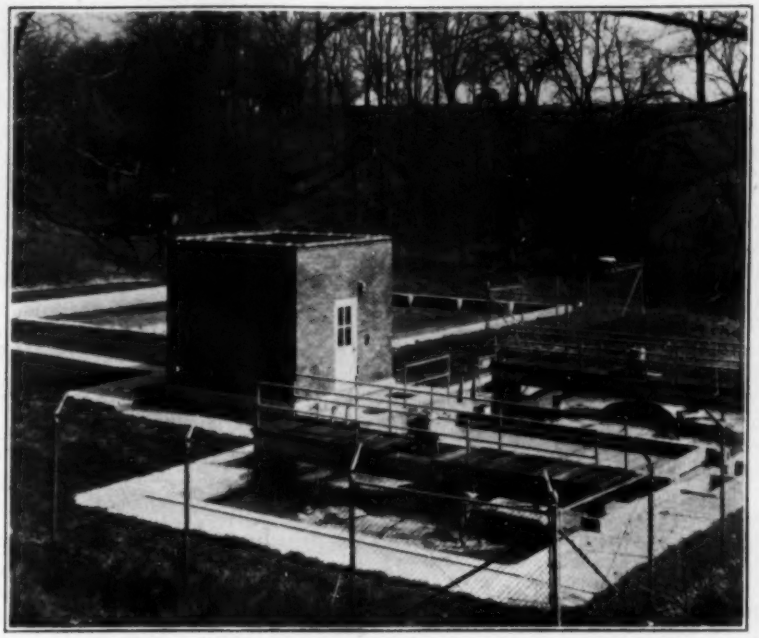


Fig. 6—KNIGHTSTOWN, IND. Mechanical aerators used at institutional plant
Design flow of this plant is 0.15 mgd.

Operating Control Procedures

An experienced operator usually can tell a good activated sludge merely by observation and by watching it settle in a glass cylinder. Activated sludge of good quality should be brown, somewhat resembling iron hydroxide in color and floc formation. A healthy activated sludge has an earthy odor resembling that of decayed wood or leaves. However, the senses of sight and smell are hardly enough to guide an operator in running a plant of the activated sludge type. He needs other tools to help him out. Many times an operator needs every test known to help guide him out of his troubles.

Perhaps the greatest amount of useful control information can be obtained by intelligent interpretation of the results of a sludge index test. This test indicates the settling quality of the activated sludge in the mixed liquor, thus indicating the desirable rate of returning sludge, and the amount of sewage flow that can adequately be treated. The concentration of mixed liquor solids and the quantity of air applied are the principal factors affecting the sludge index. It is essential to have analyses of the solid contents of the mixed liquor and of the return sludge, so that these solids can be maintained within the desired ranges.

In activated sludge plant operation the solids in the mixed liquor will obviously increase unless some solids are removed from the system. The solids are removed as sludge from the secondary settling tanks. The amount of sludge solids removed each day from secondary tanks should be equal to the solids received in the incoming sewage, in order that a constant amount of solids will remain in the system. The sludge removed from secondary settling tanks is termed waste sludge.

The time that the mixed liquor remains in the aeration tank is termed the *retention period*. The retention period required to produce a satisfactory effluent can be determined quite accurately if the B.O.D. concentration of the sewage and its rate of flow to each aerator is known. Increasing the concentration of mixed liquor solids may shorten the retention time. Retention periods required in different plants may vary from four to ten hours. Many aeration tanks are designed to remove 25 to 40 pounds of B.O.D. per day per thousand cubic feet of aerator volume. Plant operation is simplified when the loadings are at or even below the 25 pound figure.

This discussion emphasizes important factors which must be understood and applied by operators of activated sludge sewage treatment plants. It does not provide detailed operating instructions.

Summary

1. Bacteria and other microorganisms are essential in the satisfactory operation of an activated sludge sewage treatment plant.

2. These microorganisms must be adequately supplied with the oxygen which they need to carry on their life processes.

3. The starting operations of an activated sludge treatment plant must be done slowly in order to produce a good sludge.

4. Activated sludge microorganisms, like cattle, cannot be over-fed without illness developing.

5. The sludge index test is the most valuable tool in the operation of an activated sludge treatment plant.

6. An operating activated sludge plant should have a quantity of waste sludge solids drawn from the system every day.

7. An activated sludge treatment plant can be expected to remove at least 25 pounds of B.O.D. per day per thousand cubic feet of aerator capacity.

Oil Overflow Contaminates A City Water Supply

The city of Santa Paula, Calif., found it necessary to waste nearly 4 million gallons of water one day last April, in order to keep crude oil from reaching consumers' faucets and out of citrus orchards.

The reservoir was nearly full when the pollution was discovered and 3,800,000 gallons were drained into lower Santa Paula Creek to prevent the polluted water from reaching residential areas.

A tedious scrubbing job awaited the city crews, and trouble was expected for some weeks.

Now, About 100 per cent Metering!

An Open Letter from One Water Works "Super" to Another

Dear Bill,

Not long ago, I read a newspaper column captioned "The Enquiring Reporter." The question of the day was "Should the city put all water users on meters?" Now I know that you have that question in your city and I thought you might like to hear how some people answered the question.

As to the answers to "The Enquiring Reporter,"—The Commissioner of Public Works and the Director of Water both replied emphatically, "yes". Among the sound reasons for metering, they cited: (1) It is the only equitable basis for selling water. (2) It will reduce pumping and treatment costs. (3) It makes possible the determination of unaccounted-for water and helps thus to make it possible to ascertain leakage losses. (4) Often, complete metering will bring about a saving to the average user through the lower overall cost of water service.

A politician, holding an elected office was just as emphatic in saying "no". According to the political way of thinking: (1) no advantage can be shown; (2) the investment in meters and the cost of meter reading, maintenance, repair, and bookkeeping will cancel out any financial gains realized; (3) the home owner pays his proper share of the cost of water plant operation through flat rates; (4) "any move to saddle the citizens with metering is nothing more than insidious taxation."

Citizen's Viewpoints

A typist thought that the water would be cheaper for some families and that paying a metered bill monthly or quarterly would be simpler and easier than paying a flat rate twice a year; also, that the cost of meter reading would amount to less than the gains.

A movie repairman expressed the belief that with metering, people who use water all night for sprinkling would have to pay for it and less water would be wasted. He also expressed the opinion that charges for water should be under the same system as used for gas and electricity, on the basis of use.

Another man believed that water meters would make it possible for the water department to pay higher salaries and wages to its employees (who undoubtedly need more money, if that water department is like a lot of others I know). This chap also said that paying for the water one uses is certainly a fairer way of charging for the service than any flat rate system.

Some Arguments Against

Arguments against metering go back a long way in time and probably stem from the British Parliament's action fifty years ago, when it was argued that "the sale of water by meter for domestic purposes might deter some persons from using adequate quantities of water for purposes of hygiene and sanitation."

I grew up in a community of 27,000 persons, where the "poor people" had one yard hydrant which they let run in the winter to keep from freezing and also ran in summer to keep the kids and the water cool. They also had a "Chic Sale" which used no water for sanitation. Water facilities moved indoors long before metering went into effect in that city, and sanitation practices improved with the introduction of sewers but I don't recall that the kids were any cleaner behind the ears. Even then the cost of water had nothing to do with how many baths people took.

Today, in our village where we have meters, you can flush a toilet 26 times for a nickle and take eight baths for a dime and yet some diehards still cling to that old argument that wasn't even valid a half century ago.

Other arguments advanced against metering include: (1) Pressure losses through meters are appreciable and require added pressure and hence added pumping costs. (2) Water use on gardens and lawns is diminished and the economy and appearance of the community become worse. (3) Waste can be more easily checked at less cost by inspection. (4) Money spent for meters would be better spent on water works improvement. (5) Where supply is not limited, there is no need to prevent wastage.

And, Reasons For—

What too many persons don't seem to realize is that water is a commodity as well as service, which can be measured in relation to the benefit which a user obtains from it. Unlike other municipal services (fire protection, police protection, street cleaning, etc.), which cannot be directly assessed against individual benefits, water is consumed or used by an individual. It is he or his family, or property which directly benefits. Therefore, water service is not properly a tax. It should be paid for by the consumer in direct relation to his use and benefit.

The cost of meters, meter reading and maintenance does not equal the monies saved by reducing water wastage and lowering costs of treatment and pumping. Any extra pressure required is offset by water saved through reducing leakage. It's true, we use inspectors to listen for leaks and we use pitometer surveys to check leakage, but it's our regular determination of unaccounted-for water that gives us the tip-off to leakage. And we determine unaccounted-for water by comparing pumpage with the metered water we sell.

When I grew up in a water plant, the pumpage ran up to 7 mgd in summer. That was before metering. After complete metering, summer water consumption ran about 5 mgd; and, the city didn't become a desert. Last time I saw it, lawns, flowers and vegetable gardens were better than when I was a boy. The economic stability and the appearance of the town had nothing to do with whether or not the people bought and paid for the water they used, by meter, or wasted it under a flat rate.

And another thing, just because there is plenty of water, why should it be given away, or why should it be wasted at an extra cost to taxpayers. Just apply that thinking to other natural resources; coal, oil, wood, minerals, etc. etc. etc. and the argument becomes ridiculous. Besides, when you allow large volumes of water to be wasted, you have to provide extra capacity both in treatment plant, in pumping facilities and in distribution systems. Doesn't make sense, does it?

If some of these no-metering arguments were valid, why do communities which adopt 100 per cent metering always show improved operations at lower operation costs.

I hope this letter and some of these thoughts will be of some help to you in trying to sell complete metering to your customers and community and particularly to any city fathers who may be laboring under false ideas.

Yours, Mike

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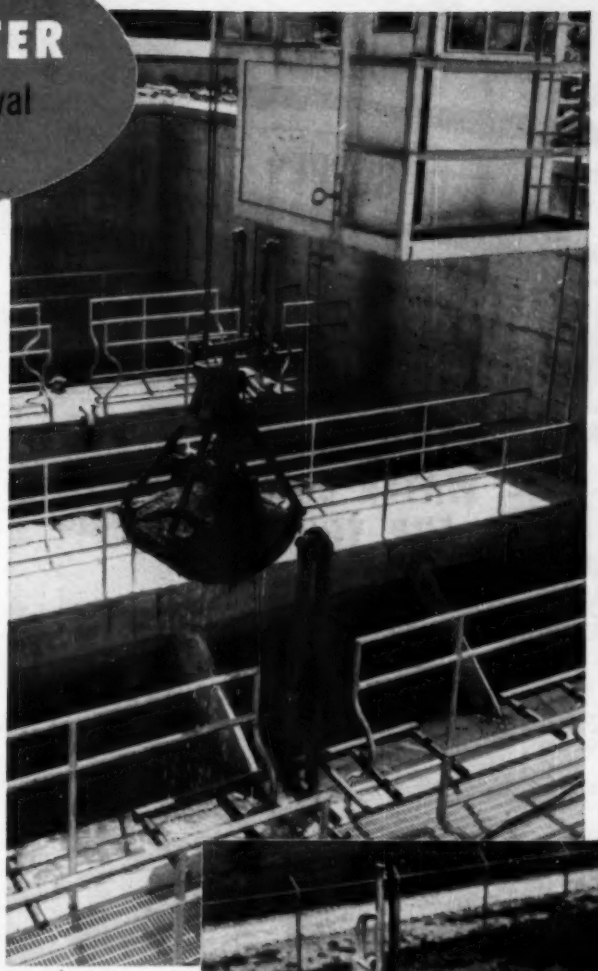
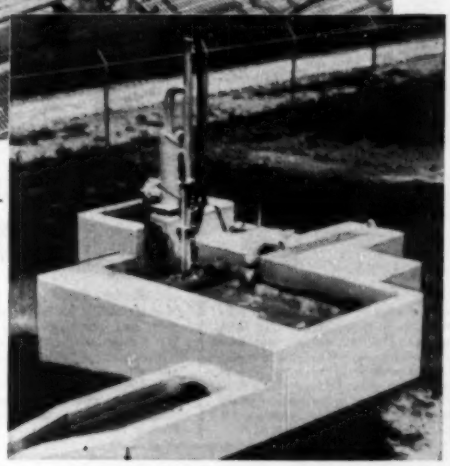


Aer-Degritter, Columbus, Ohio S.T.P. Design Flow 160 M.G.D. ***Paul A. Uhlmann & Associates, Engineers***



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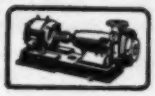

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June 14-15—Syracuse, N.Y. *(Hotel Syracuse)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Executive Committee Dinner Sunday Evening June 13. Sec'y, R. C. Sweeney, State Dept. of Health, White Plains, N.Y.

June 14-18—Chicago, Ill.
AMERICAN SOCIETY FOR TESTING MATERIALS, Sec'y, Raymond E. Hess, 1916 Race St., Philadelphia 3, Pa.

June 14-19—Atlantic City, N.J. *(Chalfonte Haddon Hall)*
AMERICAN SOCIETY CIVIL ENGINEERS. Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

June 17—Rye Beach, N.H. *(The Farragut)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Joseph C. Knox, 73 Tremont St., Boston, Mass.

June 22-25—Blackpool, England *(Jubilee Theatre, Coronation St.)*
INSTITUTE OF SEWAGE PURIFICATION. Sec'y, W. F. Freeborn, 34 Cardinal's Walk, Hampton-on-Thames, Middlesex, England.

June 22—Boonton, N.J. *(The Knolls Golf Club)*
NEW JERSEY SECTION A.W.W.A. (Summer Outing). Sec'y, C. B. Tygert, Box 178, Newark, N.J.

June 23-25—Allentown, Pa. *(Americus Hotel)*
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

June 24-26—Richmond, Ind. *(Hotel Leland)*
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, A. Paul Troemper, 2029 Bates Avenue, Springfield, Ill.

July 25-31—Sao Paulo, Brazil *(Univ. of Sao Paulo)*
INTER-AMERICAN CONFERENCE SANITARY ENGINEERING. Write to General Secretariat, Fourth Inter-American Conference San. Eng. Caiza Postal 8099, Sao Paulo, Brazil.

Aug. 11—Bingham, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 23-27—Durham, N.C. *(Duke Univ.)*
NORTH CAROLINA WATER WORKS OPERATORS' SHORT COURSE. (15th Annual Course). Chairman, J. H. Henderlite, 1515 Elizabeth Ave., Charlotte, N.C.

Aug. 23-25—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. R. Kountz, Pennsylvania State College, State College, Pa.

Aug. 25-27—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. S. Bush, Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

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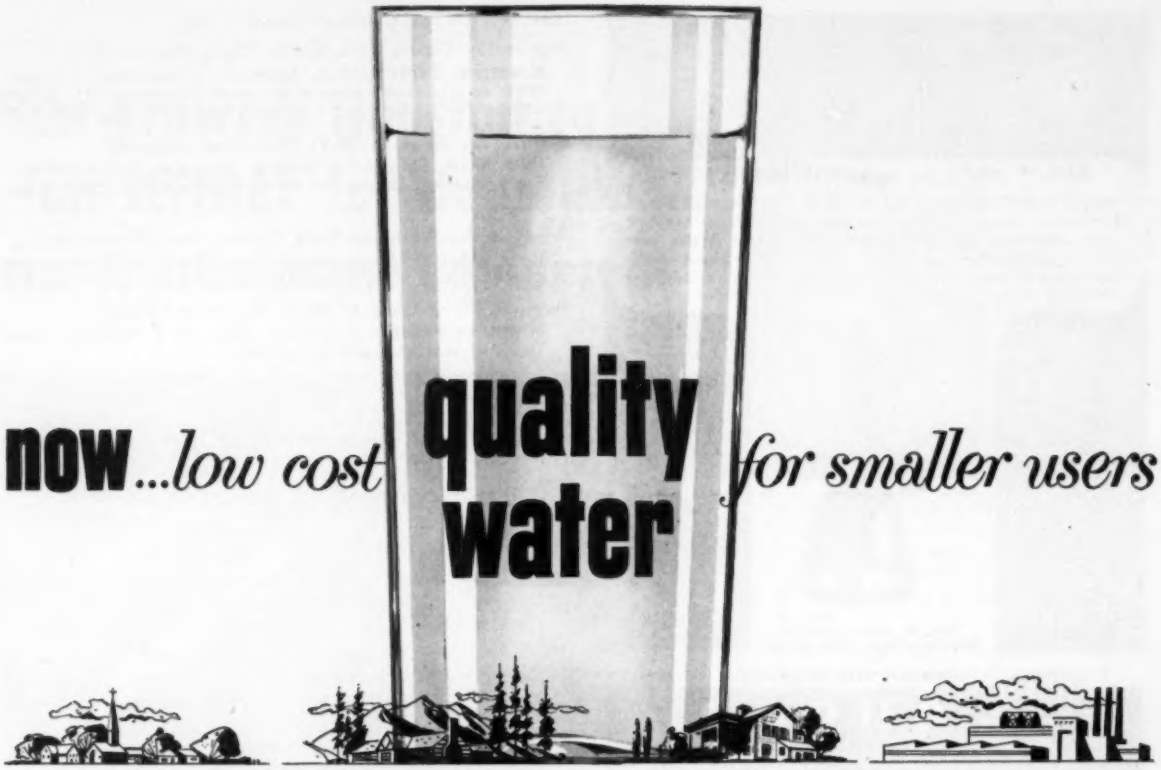

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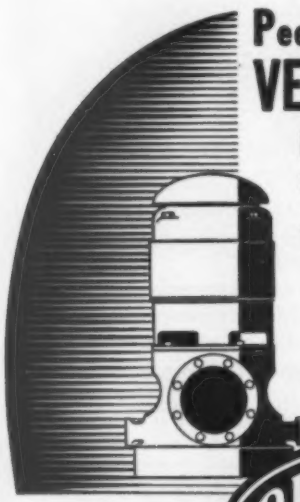

Peerless
VERTICAL
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Deep Well and Close Coupled Pumps for Water Supply, Cooling Tower Service, Flood Control, Drainage, Sewage Disposal and Process Services.

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PEERLESS PUMP DIVISION
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Offices: New York; Chicago; St. Louis; Atlanta; Phoenix; Dallas, Plainview and Lubbock, Tex.; Fresno; Los Angeles; Albuquerque.

PEERLESS BUILDS DEPENDABLE PUMPS

(*Continued from page 78A*)

Sept. 8-11—Digby, Nova Scotia *(Digby Pines Hotel)*
MARITIME PROFESSIONAL MEETING, ENGINEERING INSTITUTE OF CANADA, ASSOCIATION OF PROFESSIONAL ENGINEERS. Write, G. W. Frey, P.O. Box 1507, Halifax, N.S.

Sept. 9-10—Montauk, N.Y. *(Hotel not selected)*
NEW YORK SECTION A.W.W.A. (Annual Fall Meeting). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.

Sept. 14-16—Waterloo, Iowa *(Hotel Russell-Lampson)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 15-17—Muskegon, Mich. *(Occidental Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, Dept. of Health, Lansing 4, Mich.

Sept. 19-22—Atlantic City, N. J. *(Hotel Claridge—Exhibits, Convention Hall)*
AMERICAN PUBLIC WORKS ASSOCIATION. Exec. Dir. Donald Herrick, 1313 E. 60th St., Chicago 37, Ill.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 420 6th Ave. N., Nashville, Tenn.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, R. Paul Farrell, 420 6th Ave. N., Nashville 3, Tenn.

Sept. 22-24—Dayton, Ohio *(Biltmore Hotel)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

Sept. 22-24—Regina, Sask *(Saskatchewan Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.

Sept. 22-24—Grand Forks, N.D.
NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE. Sec'y, Jerome H. Svore, State Dept. of Health, Bismarck, N.D.

Sept. 22-24—Atlanta, Ga. *(Ga. Institute of Technology)*
GEORGIA WATER & SEWAGE SHORT SCHOOL. Write, A. T. Storey, 1210 Hemphill Ave., N.W., Atlanta, Ga.

Sept. 26-28—Jefferson City, Mo. *(Governor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Sept. 28-30—Green Bay, Wis. *(Northland Hotel)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

Oct. 4-5—Moncton, New Brunswick, Can. *(Hotel Brunswick)*
MARITIME BRANCH, AMERICAN WATER WORKS ASSOCIATION. Sec'y, J. D. Kline, P.O. Box 574, Halifax, N.S.

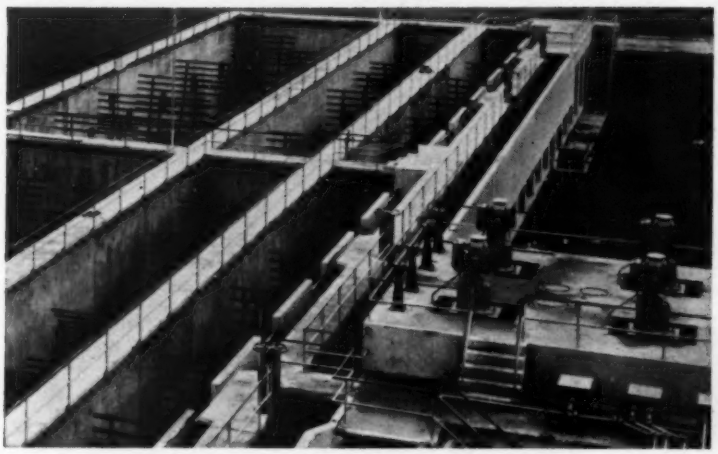
Oct. 4-6—Poland Spring, Me. *(Poland Spring House)*
NEW ENGLAND WATER WORKS ASSOCIATION. (73rd Annual Convention). Sec'y Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Oct. 4-6—Atlantic City, N.J. *(Chalfonte-Haddon Hall)*
PENNSYLVANIA MUNICIPAL AUTHORITIES ASSOCIATION. Sec'y, Claude C. Fogelman, 1717 Main St., Northampton, Pa.

Oct. 6-8—St. Paul, Minn. *(Hotel not selected)*
MINNESOTA SECTION A.W.W.A. Sec'y, Leonard N. Thompson, Gen. Mgr., Water Department, St. Paul, Minn.

(*Continued on page 82A*)

Fast-growing Houston called on JEFFREY for dependable water treatment equipment



Jeffrey sanitary engineering and equipment can be applied effectively to any American city with "growing pains and a thirst."

Jeffrey's broad experience in the design and construction of sanitation systems covers all types of installations. You can turn your sanitation problem over to Jeffrey with complete confidence.

Hundreds of water, sewage and industrial waste plants throughout the nation are now Jeffrey-equipped. The complete Jeffrey line for Water Treatment Plants includes:

- Bar and Disc Type Screens
- Screenings Grinders
- Grit Collectors & Washers
- Sludge Collectors
- Sludge Elevators
- Scum Removers
- Power Transmission Machinery
- FLOCTROLS
- Dry Feed Chemical Machines
- Biofiltration Plant Equipment
- Garbage Grinders
- Belt and Spiral Conveyors
- Bucket Elevators
- Chains and Sprockets

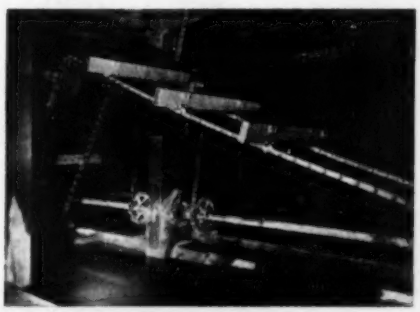
Write for Catalog 833-A

Below: A complete chemical handling system utilizing Jeffrey Power Scoop, Spiral Conveyors and Bucket Elevators. Material flows uninterrupted from cars to storage bins or chemical feeders.

At left: 14 Jeffrey FLOCTROLS, each 54' long, driven by 1½ hp. motor, have peripheral paddle speed of 1.2 to 1.8 ft. per second . . . 45-minute detention at 80 mgd. Note four Jeffrey Rapid Mixers at right.

Below: Jeffrey Spiral Conveyors carry chemicals from storage bins by bucket elevators to chemical feeders.

Below: Close-up of Jeffrey Sludge Collectors in action in the settling tanks of Indianapolis Water Co.'s White River plant.



THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED . . . IT'S A JOB FOR JEFFREY!

(*Continued from page* 80A)

Oct. 11-14—Cincinnati O. *(Netherland Plaza Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. (27th Annual Convention). Exec. Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(In conjunction with)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT ASSOCIATION. Sec'y, Ward E. Conrad, 301 Ohio Departments Bldg., Columbus 15, Ohio.

Oct. 11-15—Buffalo, N.Y. *(Statler Hotel—Tech. Sessions, Memorial Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting). Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N.Y.

Oct. 13—Brunswick, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 13-15—Cedar Rapids, Iowa *(Roosevelt Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 17-20—El Paso, Texas *(Cortez Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 18-20—Pittsburgh, Pa. *(Hotel William Penn)*
ENGINEERS SOCIETY OF WESTERN PENNSYLVANIA. (15th Annual Water Conference). Sec'y, W. M. Porter, Hotel Wm. Penn, Pittsburgh, Pa.

Oct. 18-22—New York, N.Y. *(Statler Hotel)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Annual Meeting). Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

Oct. 19-22—Atlantic City, N.J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, David Dunlap, 504 N. Second St., Harrisburg, Pa.

Oct. 24-27—Birmingham, Ala. *(Tutwiler Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, State Department of Health, Montgomery, Ala.

Oct. 26-29—Long Beach, Calif. *(Wilton Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 27-28—Springfield, Ill.
ILLINOIS WATER WORKS OPERATORS CONFERENCE. Sec'y, Clarence W. Klassen, State Dept. of Health, Springfield, Ill.

Oct. 27-29—Baltimore, Md. *(Hotel not selected)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl Lauter, 6955 33rd St., Washington 5, D.C.

Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanagh, 915 Colonial-American Bank Bldg., Roanoke 11, Va.

Nov. 4-6—Atlantic City, N.J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.

Nov. 8-9—Huntington, W. Va. *(Hotel Prichard)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston 5, W. Va.

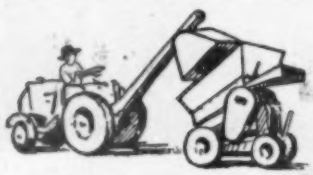
Nov. 7-10—St. Petersburg, Fla. *(Soreno Hotel)*
FLORIDA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 316, Coconut Grove Sta., Miami 33, Fla.

Nov. 8-10—Asheville, N.C. *(George Vanderbilt Hotel)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, P.O. Box 2091, Raleigh, N.C.

Nov. 9-10—Colorado Springs, Colo. *(Broadmoor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, Box 600, Denver, Colo.

Nov. 9-10—Huntington, W. Va. *(Prichard Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, G. O. Fortney, State Dept. of Health, Charleston, W. Va.

Nov. 11-12—McCook, Neb. *(Keystone Hotel)*
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Paul W. Mousel, 602 West B Street, McCook, Neb.



no hand shoveling

with the new

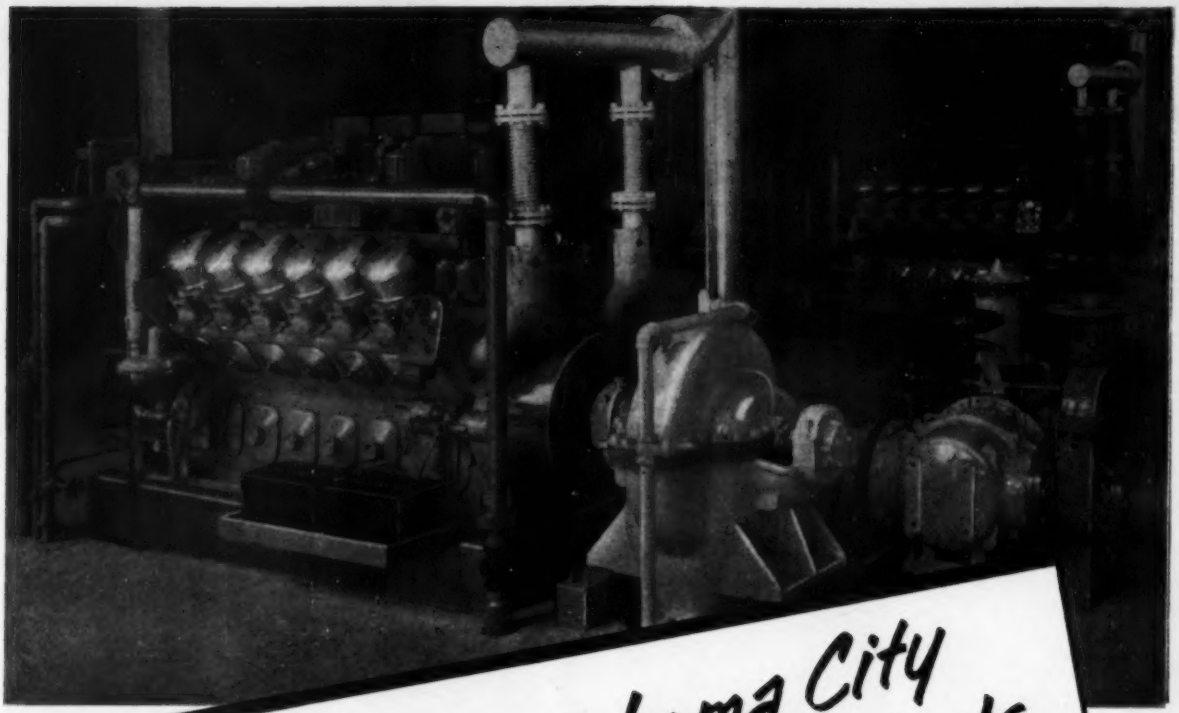
high capacity . . . bucket fed

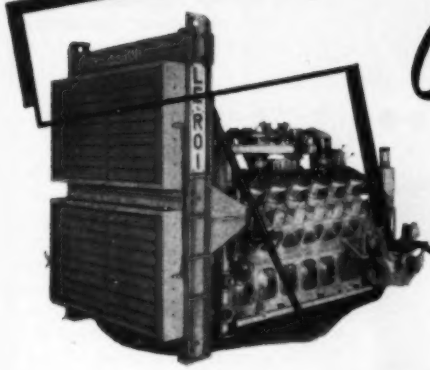
ROYER DISINTEGRATOR

Newest in the line of Royer Sludge Disintegrators is the model NSYP-E, a unit capable of handling up to 150 cubic yards of sewage sludge per hour . . . mechanically fed by a front end tractor bucket. Where large quantities of sludge are processed into fertilizer, this machine entirely eliminates the slow, costly work of hand shoveling. With the large 3' wide "combing belt" and the 60" wide receiving hopper, this unit can receive and process the contents of a 12 cubic foot bucket as fast as the loader can deliver.

A machine of like capacity is available in an "over-the-road" model, powered with a 36 HP air cooled Wisconsin gasoline engine and mounted on four 6.00x16 tires, with tow-bar and automotive steering. Write for data on the many Royers available in capacities from 1 to 150 cu. yds. per hr.

ROYER foundry & machine co.
170 PRINGLE ST., KINGSTON, PA.
ROYER





Oklahoma City Water Dept. tests its Le Roi L3460 Engines

...proves their economy in municipal service!

THESE figures show you the kind of economy many municipalities enjoy by using Le Roi power:

On a 221-hour test run in Oklahoma City, two standby pumps powered by Le Roi L3460's...

...pumped an average of 7677 GPM each

...used only 990 cubic feet of gas per million gallons

...used only .43 gallon lube oil per million gallons pumped.

Engine operating costs were about one-half of the 760 KWH per million gallons required to pump by electricity. That's the kind of performance that saves money for taxpayers!

One of the underlying reasons for the economy and dependability of Le Roi engines is the fact that they are built by a manufacturer who concentrates exclusively on heavy-duty engine design.

Give *your* community the advantages of Le Roi power. Le Roi engines are available in sizes ranging from 20 to 600 hp — custom generator sets in sizes from 50 to 300 KW. They operate on no-cost sewage gas, natural gas, butane, or gasoline.

E-84

Write today for detailed information

LE ROI

LE ROI COMPANY

A Subsidiary of Westinghouse Air Brake Co.

Dept. WA-6 • 1706 S. 68th Street • Milwaukee 14, Wis.

Plants:
MILWAUKEE
CLEVELAND
GREENWICH, OHIO

Technical Manual for Emergency Operation of Water Facilities

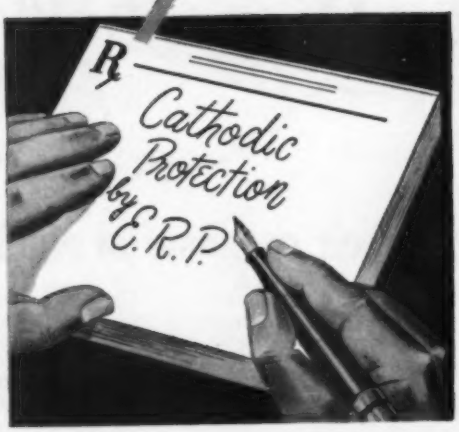
The Federal Civil Defense Administration has issued a technical manual describing the operations, functions, and requirements of water utilities during civil defense emergencies.

"Operation and Repair of Water Facilities in Civil Defense Emergencies" is divided in two parts. Part 1 discusses procedures for distribution of water for essential emergency needs, especially fire fighting. Part 2 discusses maintenance of a safe supply, including detection and identification of contaminants.

For copies of the booklet, send 25c to the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C.

Rx FOR CORROSION...

You don't need a specialist to *recognize* Corrosion. But you do need one to treat it successfully. The skill required to achieve complete corrosion control comes only from the knowledge and experience gained through years of practical application.



Recognition of that fact is one reason more and more people are turning to E.R.P. for assistance on corrosion problems — one reason that thousands of buried or submerged steel structures of all types have been completely protected against corrosion by E.R.P. engineers. Corrosion specialists *for over 17 years*, these men are highly trained and well equipped to help you with *your* corrosion problem. Write for full information today.

COMPLETE CATHODIC PROTECTION SERVICE • DESIGN ENGINEERING MAINTENANCE INSTALLATION EQUIPMENT

ELECTRO RUST-PROOFING CORP. (N. J.)
BELLEVILLE 9, NEW JERSEY
REPRESENTED IN PRINCIPAL CITIES IN THE UNITED STATES

E-27

33 Yr. "Vet." Eigenrauch Not a "Programmer"

Correction to N.J. Meeting Report

In our May issue report of the New Jersey Sewage & Industrial Waste Assn. annual meeting, on page 233, we carried a photograph of Wm. Eigenrauch with a group of "programmers."

"Bill" Eigenrauch was not a programmer at the meeting, but is a veteran New Jersey plant operator. For 33 years he has been continuously employed by the Borough of East Rutherford since January 1, 1921.

First serving as operator of the Borough's treatment plant (the Borough is now served by a Joint Meeting plant), veteran Eigenrauch is now in charge of all sewer connections in East Rutherford.

Jersey City Sewer Trial Ended—Decision Pending

According to press reports, the nine-week Jersey City, N. J., trial to upset sewer contracts was ended on April 9th. The court reporter told Superior Court Judge Joseph L. Smith that at least one month will be required to prepare transcripts of the summations the Judge requires. Judge Smith gave no indication of the additional length of time needed before he will decide the case.

The trial was started in January by S. John Famiglietti and Ben Schlossberg in an attempt to void $31,000,000 in contracts awarded by the Jersey City Sewerage Authority beginning last September 10th.

"Fresh Water from the Ocean"

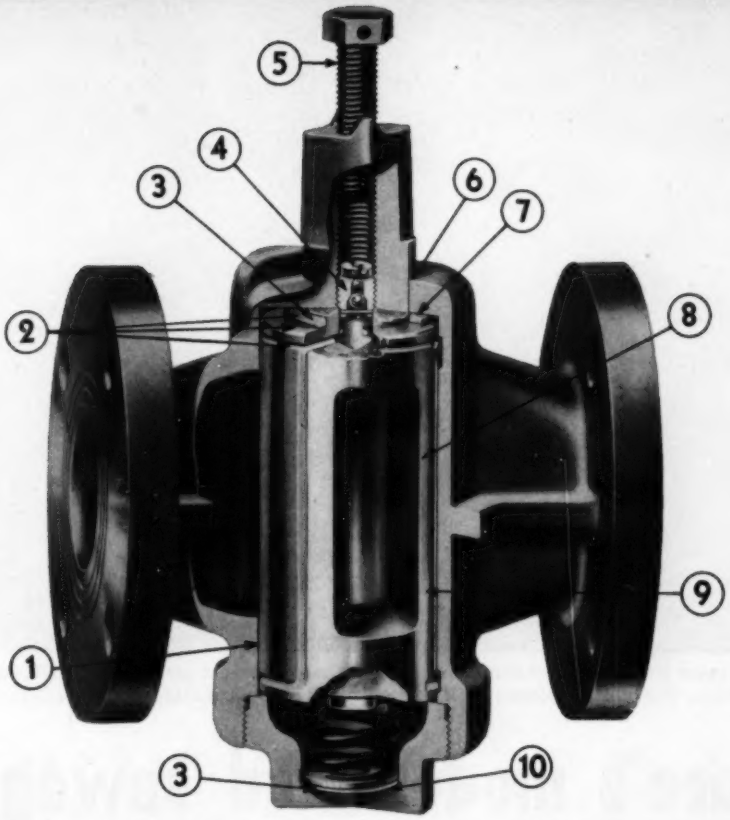
A New Book

A new book titled "Fresh Water from the Ocean" investigates the possibilities of producing fresh water from the ocean in projected quantities of 1,000 million gallons every 24 hours, approximately the daily consumption of New York City. This comprehensive study of 217 pages was prepared by Cecil B. Ellis and members of the staff of Nuclear Development Association, Inc., under

(*Continued on page* 88A)

NEW HOMESTEAD
lubricated plug valve

(Patents Pending)



with features that guarantee longer, low-cost service

. . . and really low priced!

1. Close tolerance between sealing surfaces—extra long valve life—less lubricant needed.
2. Triple head seal—two rings of lubricant, and a teflon sealing ring prevent leakage.
3. Plug floated on teflon rings—low friction—extra ease of turning.
4. Leakproof double-ball and lubricant sealed check valve—no springs—no maintenance.
5. Full-threaded screw prevents dirt from being forced into lubricant system.
6. Extruded lubricant shows when system is full. Minimum contamination of line fluids.
7. Reinforced teflon seal—no cold flow—continuous positive seal.
8. 100% pipe area or venturi patterns.
9. High pressure lubricant system forces chemical seal over all seating surfaces. Full lubricant seal around ports.
10. Spring torsional stress relieved by teflon washer—less maintenance—longer life.
11. No mechanical adjustments—human error minimized.
12. Two lubricants handle most all services.

Mail coupon for catalog and complete details.

HOMESTEAD VALVE MANUFACTURING CO.

Makers of Cam-Sealed and Lever-Sealed Plug Valves, Hydraulic Operating Valves, Boiler Blow-Off Valves, Hypressure Jenny Steam Cleaners and Compounds.

"Serving Since 1892"

P.O. Box 42, Coraopolis, Pa.

200 Sales Representatives

Without obligation, please send Reference Book 39 Section 5 and prices on Homestead Lubricated Plug Valves.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

ENGINEERING REPORTS:

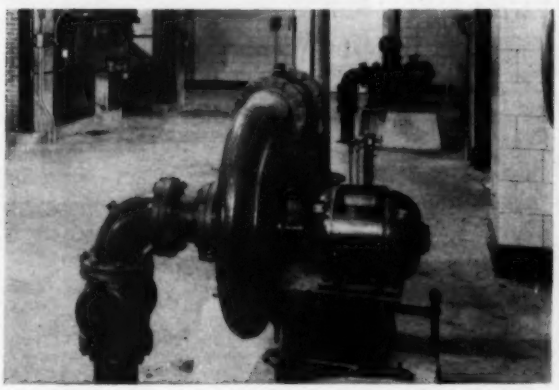
AERIAL VIEW of Baltimore treatment plant shows layout of settling tanks and filters. The plant, serving the Baltimore area, handles an average of 130 mgd. Architect was Lucius R. White; general contractor was the Chesapeake Contractors.

Baltimore's modernized sewage plant

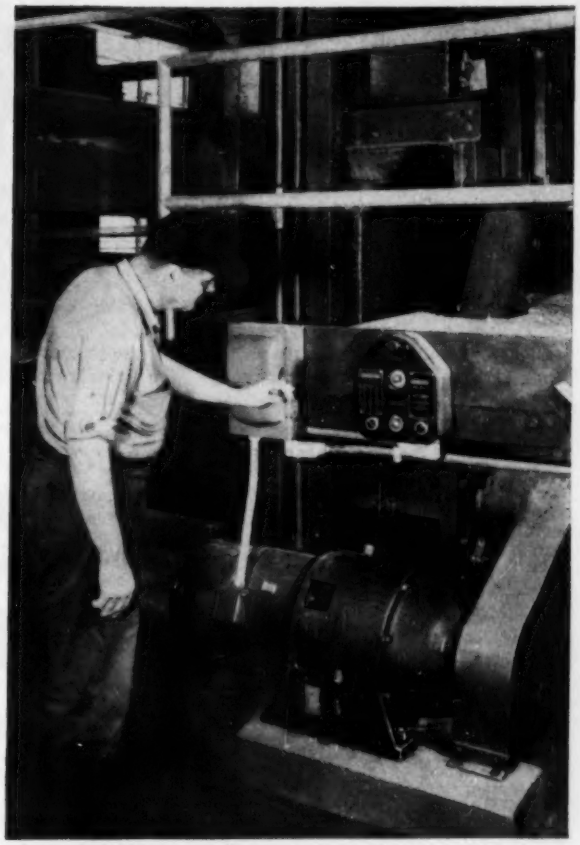
MAIN PROCESS CONTROL panel for the sludge-drying plant is this G-E Cabinetrol* panel. G-E Apparatus Sales engineers helped to plan installation to fit the exact needs of the plant.

*Reg. trade-mark of General Electric Co.

VAPOR FAN, driven by 60-hp G-E motor, removes moist air from cyclone and discharges it into the furnace for drying.



GAS BOOSTER, driven by G-E 7½-hp motor, increases pressure of gas coming from digester tanks for plant utilization.



EFFICIENT DRIVE for the mixer is supplied by this economical, easily maintained 15-hp G-E gear-motor.

brings CLEAN WATERS to Back River

G-E equipped sewage treatment plant expansion completes sludge-drying project for the city

In January, 1953, Baltimore's newly modernized drying plant went into full operation. Owned and operated by the city of Baltimore, it was built to safely handle the city's waste and to help decontaminate the Back River, making it safe for recreation. This one plant handles the major part of the entire Baltimore area.

Consulting engineers Whitman, Requardt & Associates and electrical contractor Blumenthal Kahn Electric Co. utilized G-E application engineering aid in specifying and installing the G-E Cabinetrol panel, which controls power distribution of low-voltage power for the drying plant.

SPECIALISTS IN SEWAGE-PLANT ELECTRIFICATION, G-E application engineers are ready to work with *your* engineers and consultants and contractors to help design a co-ordinated electrical system for your new plant or modernization project. Contact your local G-E Apparatus Sales Representative early in the planning stage. And to gain public support for your new sewage facilities, ask him now how you can put the G-E "More Power to America" film, CLEAN WATERS, to work in your community. General Electric Co., Schenectady 5, N. Y. 666-81

Engineered Electrical Systems for Sewage Plants

GENERAL ELECTRIC

(*Continued from page* 84A)

the sponsorship of the Conservation Foundation.

In a practical discussion of how to relieve the water-short areas of the world, Mr. Ellis has analyzed the basic matter and energy relationships with which any sea-water conversion method must deal. These considerations provide the basis for figuring all major cost items. The author considers requirements which must be evaluated in producing water for drinking, for industry, and for irrigation.

Various conversion methods are described and their economic feasibility is analyzed with respect to plant construction, labor cost, maintenance, raw materials, and power. The big question presented in the book is "What method of extracting suitable drinking and irrigation water from the ocean would cost the least over a 30-year period?"

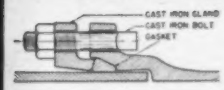
The conclusions are that within no longer than, say 10 years from now it should be possible to extract fresh water from the ocean on a large scale at a total cost of about 30 cents a thousand gallons at a cheap-power location. If the converted water is to be used away from the seacoast in the interior, the cost of pumping the fresh water inland will have to be added to this estimate.

Published 1954 by The Ronald Press Co., 15 East 26 Street, New York 10, New York. Price $5.00.

MECHANICAL JOINT HYDRANT

MH EASY to INSTALL

Saves Labor
Saves Time



Made-up Mechanical Joint cut away to show its design.

A. W. W. A.

The use of mechanical joints for pipe, valves and hydrants is growing rapidly. The reasons are easy assembly, saving in time and labor cost, and flexibility that maintains a tight, leak-proof joint under conditions such as pipe line expansion, contraction or settling.

M & H Mechanical Joint hydrant is standard compression type. The main valve opens against the pressure. Hydrant valve will remain closed in case hydrant standpipe is broken off in traffic accident. Other features include low friction loss, revolving head, dry top, easy lubrication. Hydrant shoe has two heavy lugs for use in strapping hydrant to dead-end pipe line.

M & H Mechanical Joints are made in accordance with A.S.A. standard specification A21.11, 1952, as approved by American Water Works Association, in which a thick gasket of triangular cross section is compressed by a bolted follower ring.

For complete information, write or wire M & H VALVE AND FITTINGS COMPANY, Anniston, Alabama.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Pipe Welding Technique Saves Money, Time, Materials

601

Stone & Webster Engineering Corporation, Boston, Mass., has developed a new pipe welding process that is reported to save money, time and materials.

The process involves gas shielded arc welding of pressure piping used in the petroleum, gas, public utilities and waterworks industries. Joints are welded faster because no metallic backing rings are required, possible wrinkles are eliminated and any former obstructions are removed. The new pipe-line welding process was developed under the supervision of R. T. Pursell, who heads the metallurgical and welding laboratory of Stone & Webster concerned with the use of all types of ferrous and nonferrous metals.

H. E. Schlenz

L. E. Langdon

Executive Election At Pacific Flush Tank

The Pacific Flush Tank Co., Chicago, Illinois, has announced the election of the following officers: Harry E. Schlenz, President; Lawrence E. Langdon, Vice President and Sales Manager; Clifford B. Cox, Secretary; Dorothy M. Burwell, Treasurer; and Newton C. Turcot, Controller.

(*Continued on page* 90A)

Alco STEEL PIPE used for Water Supply in New York City's Borough of Queens

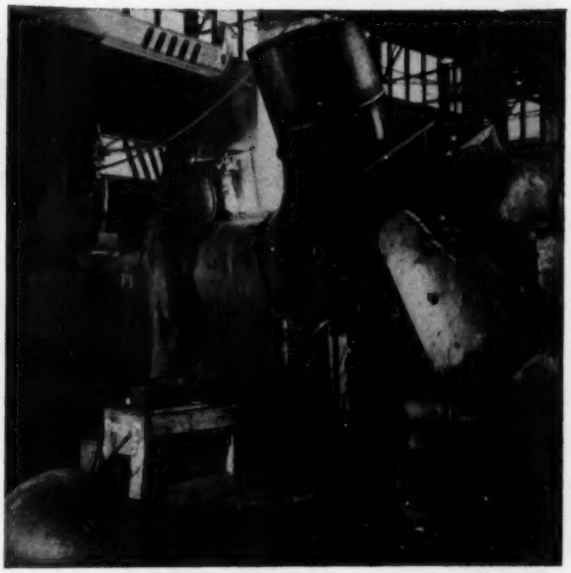
When a large new line was planned for New York City's thriving Borough of Queens, Alco received an order for Electric Welded Steel Pipe—17,250 ft of 72-in. and 1000 ft of 60- to 20-in. pipe, plus specials.

In strict accordance with specifications of the City's Department of Water Supply, Gas and Electricity, the pipe is fabricated of ½-in. thick steel plate, lined on the inside and coated on the outside with coal-tar enamel, and wrapped with coal-tar saturated asbestos felt. Field joints are riveted.

For your specifications, Alco Electric Welded Steel Pipe is available in diameters from 20 to 120 in., and lengths to 40 ft without girth seams in diameters 30 in. and up.

It is the choice of engineers and contractors all over the country for its strength, efficiency, economy and long life. Consider Electric Welded Steel Pipe for your installation—special or standard, whatever its size. For complete technical data—and expert assistance with your special problems—contact your nearest Alco Products sales representative.

THE WORLD'S LARGEST water system grows even larger as New York City's Borough of Queens adds 17,250 ft of 72-in. and 1000 ft of 60- to 20-in. Alco Electric Welded Steel Pipe.



COMPLETE FACILITIES for fabricating pipe, connections and specials enable Alco to meet your installation requirements at low first cost and with superior quality.

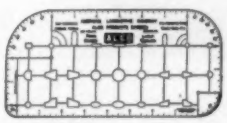
Remember these Key features of Alco Steel Pipe

STRONG: Unaffected by vibration. Maximum resistance to shock, and to overloading from earth movement and washout.

EFFICIENT: Positively watertight. Minimum number of field joints. Smooth coal-tar enameled interior surface for highest flow rate.

ECONOMICAL: Low first cost. Long lengths, light weight for easy installation.

DURABLE: Life in water supply installations estimated conservatively at 75 to 100 years.



For information on how to obtain one of these handy Alco Piping Templates, write to your nearest Alco Products Sales Office.

ALCO PRODUCTS

AMERICAN LOCOMOTIVE COMPANY

Sales and Service Offices in Principal Cities

(*Continued from page 88A*)

At the same time it was announced that Lester E. Rein, who has been associated with the Company since 1901, nine years after its organization, and has served as President since 1934, was elected to the newly constituted office of Chairman of the Board.

Harry E. Schlenz has been active in sales promotional work with the company since 1930, served as Secretary from 1934 to 1936, and as Vice President and Sales Manager since 1936.

Lawrence E. Langdon has served the Company since 1932 as Chief Engineer and later in sales promotion, and was Secretary from 1936 to 1948, and Treasurer since 1948.

Clifford B. Cox has been with the Company since 1933, serving in the capacity of Chief Engineer and later Customer Relations activities, and has been Secretary of the Company since 1948.

Dorothy M. Burwell returns to the office of Treasurer, which was previously held by her from 1936 to 1948.

Newton C. Turcot has been with the Company since 1947 and has been Controller since 1951.

water **is important to everybody...**

The Miss at this fountain of youth would be mighty disappointed if low water pressure were suddenly to deprive her of a drink—and so would millions of others who take water pressure for granted. One of the best, and least expensive ways to assure the constant flow of water is through Centrilining.

The Centriline process thoroughly cleans and centrifugally applies cement-mortar to the interior of pipe lines in place—prevents corrosion, tuberculation and leakage; minimizes interruption of line operation and street traffic. For an effective, economical means of increasing flow capacity, look to Centriline.

Write for free booklet today.

CEMENT-MORTAR LININGS FOR PIPES IN PLACE

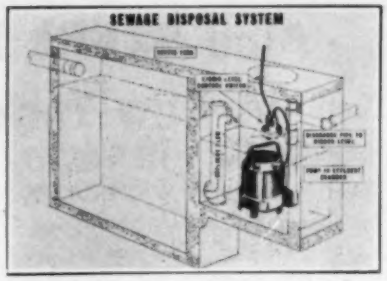
3,000,000 FEET OF EXPERIENCE

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET, NEW YORK 6, N. Y.

Branch Offices in Principal Cities of United States and Latin America



Submersible Pump Simplifies Septic Tank Installation

602

Kenco, Inc., Lorain, Ohio, has announced a new application for the Kenco Submersible Sump Pump that solves the problem of high costs in septic tank installations, where it is desirable and necessary to raise the effluent leaving the septic tank to a higher level into a tile disposal field or filter bed.

The sump pump is installed in a secondary vented overflow chamber adjacent to the septic tank where it pumps the effluent through a pipe that discharges into a level filter bed or tile disposal field.

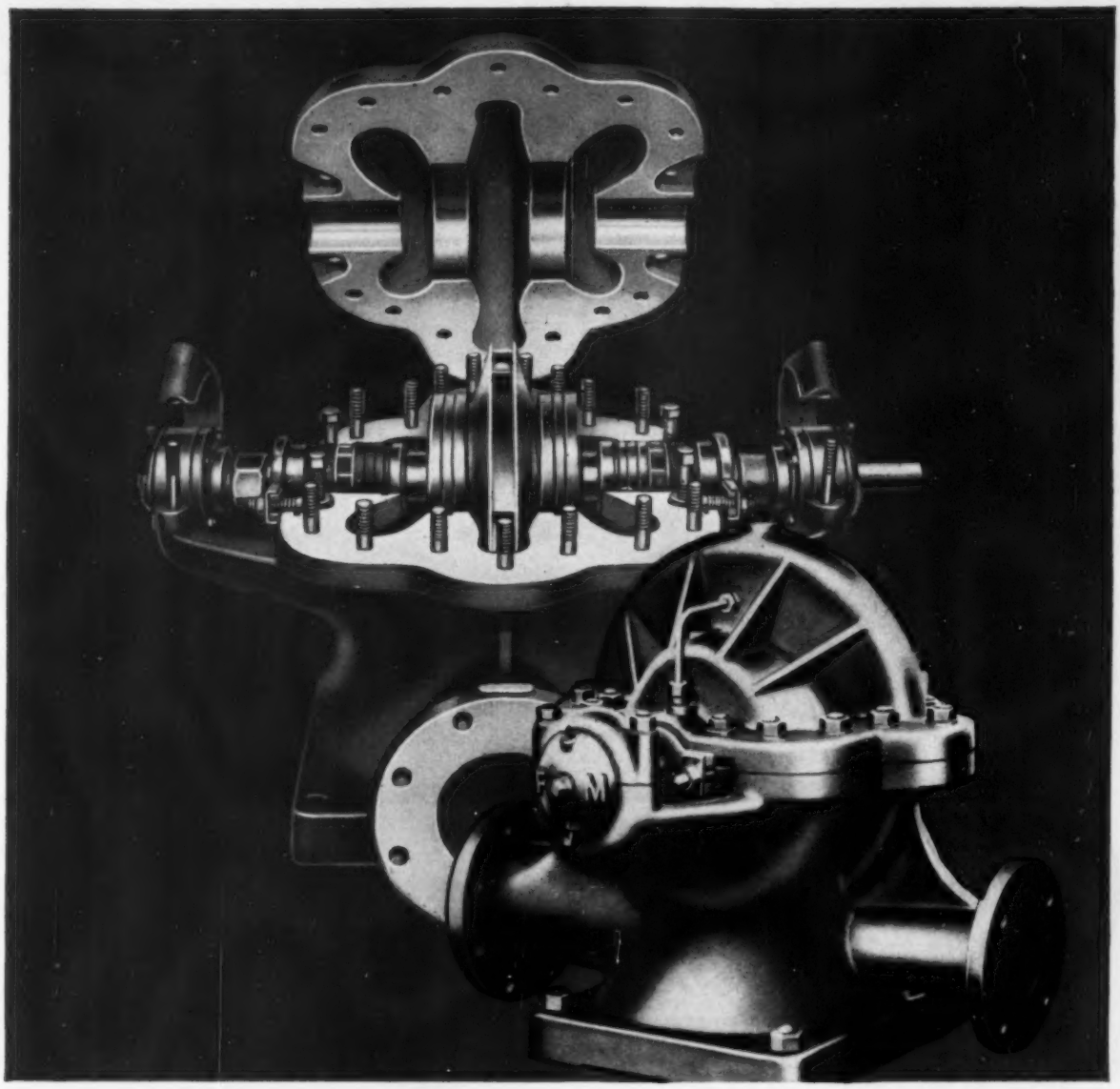
The pump has a capacity of 3300 GPH, and operates completely submerged in liquid. Made of corrosion-resistant bronze, it will fit into a 12 inch cube. A two-stage, No-Float liquid level switch controls the pump, and it can be set to "turn-on" at any desirable point, and to remove the liquid to within 5/8 inch of the pit floor.

Darling Valve Appoints Engstrom Midwest Sales Manager

The Darling Valve & Manufacturing Co., Williamsport, Pa., has announced the appointment of Mr. Bertil E. Engstrom as Midwest Regional Sales Manager.

Mr. Engstrom joins Darling Valve after six years with Minneapolis-Honeywell where he served as Assistant Sales Manager, and more recently as Regional Sales Manager. He attended the University of Wisconsin, Illinois Technical Institute, and the Duluth Business University.

(*Continued on page 92A*)



out of the mouth of a pump...

Suppose a pump could "spill its works" . . . tell you how it was made . . . speak of the design, material, workmanship that went into its being . . . then you could know . . . and buy with confidence.

Because after all, pumps do look very much alike. How, then, to tell which make is best for you. *Reputation* is one way, *performance* another.

And, on both counts, Fairbanks-Morse pumps stand out. Don't take our word for it. Check with Fairbanks-Morse users. We'll stand by their verdict. For Fairbanks-Morse has only one standard . . . *quality* . . . the quality that means dependability, service, low maintenance, all those important points that you want in the pumps you buy.

To get these advantages in your pumps, rely on the world's largest manufacturer of a complete pump line. See your nearest Fairbanks-Morse Branch, pump dealer, or write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS

(*Continued from page* 90A)

Born in Sweden, Mr. Engstrom is married, has three children, and plans to continue his Chicago residence. He will head Darling Valve sales in roughly a dozen states extending from the east Ohio border to the west border of the Dakotas, to the south border of Kentucky.

Hodgson Receives 35-Year Pin From National Water Main

The National Water Main Cleaning Company, New York, N.Y., has announced that at a luncheon during the recent meeting of the Southeastern Section of the A.W.W.A., Mr. J. L. Hodgson, Southeastern Sales Manager of the Company, was awarded an emblem in commemoration of his 35-years service with the Company.

The above picture shows Mr. Hodgson receiving the pin from Mr. J. A. Frank, Vice President and General Manager of the National Water Main Cleaning Company.

All-Purpose Ace-Flex Tubing

603

American Hard Rubber Company, New York, N. Y. has announced Ace-Flex, a new all-purpose, transparent plastic tubing with unusual flexibility. Ideal for any temporary or permanent fluid lines where easy-to-handle, sturdy, flexible tubing is required, Ace-Flex is inert, odorless, non-toxic, and ages well. It is highly resistant to most inorganic acids and alkalis, and is resistant to many organic chemicals.

The smooth, shiny, non-tacky finish of Ace-Flex permits quick and easy cleaning, and it may be steam sterilized. It is light in weight, abrasion-resistant, and retains its clear transparency through long life.

Ace-Flex is kink-resistant and easy to assemble. With a rubbery, elastic quality, it can be connected to glass, metal or plastic fittings simply by dipping in soapy water and slipping over the fitting. Couplings for the tubing can easily be made by slipping the tubing into short pieces of Ace-Flex having an inside diameter the same as the outside diameter of the tubing to be joined. Ketone type cement may be used to weld permanent joints. Hose clamps may also be used, though they usually are not necessary.

Standard sizes are available with inside diameters ranging from 0.120" to 1".

Santandrea Appointed District Manager for Warren Foundry

Warren Foundry & Pipe Corporation, New York, N.Y., has announced the appointment of Mr. Anthony Santandrea as District Manager, New York Sales.

(*Continued on page* 94A)

LEBANON, OREGON
REPORTS 6 YEARS OF SATISFACTION
WITH "*Flexibles*"

Six years ago, April 7, 1948, the typical American City of Lebanon, Oregon, purchased a set of two "Flexible" Bucket machines. They are still rendering perfect service, and have more than paid for themselves many times over in labor saving costs, more sanitary and more perfectly operating sewers, citizen convenience and putting workers on the dignity of "street level."

Since then, of course, "Flexibles" have been vastly improved and modernized in keeping with our policy of careful study and "follow through" of sewer-cleaning needs and problems . . . as we have for 20 years Both of problems in general and individual city needs in particular.

Seen in the picture are E. C. McClean, Street Superintendent, of Lebanon, and Les Thompson, of Corvallis.

The arrow points to a golf club with a pair of spectacles attached which were unearthed in this particular cleaning operation.

Write for our **FREE** *Catalog*

Flexible **SALES CORPORATION**

3786 Durango Ave., Los Angeles 34,

(DISTRIBUTORS IN PRINCIPAL CITIES)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

Photos show part of 600-ft. sewer section laid on a 200-ft. radius with 66-in. concrete pipe made in six-ft. lengths.

New Memphis Storm Sewer Uses 13,000 ft. of CONCRETE PIPE

Memphis, Tenn. discovered the economy of concrete pipe years ago. That's why it was chosen for a new storm sewer just north of the Jackson Avenue Viaduct.

The photos show the installation of a portion of this sewer. About 13,000 ft. of concrete pipe (ASTM specification C76, Table I) varying from 15 in. to 66 in. were required. The pipe was laid by dragline on Class "C" bedding in trenches that averaged 12 ft. in depth. Backfill was tamped in 6-in. layers to one foot above the top of the pipe.

Engineers throughout the country know they can depend on concrete pipe for great structural strength, maximum hydraulic capacity, minimum infiltration and leakage and unusual resistance to abrasive matter. These qualities have been demonstrated in hundreds of storm and sanitary sewers all over America.

As in Memphis, engineers and taxpayers both appreciate the economy of concrete pipe. It is moderate in first cost, requires little or no maintenance and has extra long life. The result: ***low-annual-cost*** service.

AMERICAN CONCRETE PIPE ASSOCIATION

228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS

CONTROLS that are dignified by a background of long experience and infallible operation. ROTO-TROL 940 controls pumps, valves, alarm circuits, etc., from one float. Starting and stopping positions, rising and falling, can be set as required. Each circuit is independent. Mercury switches with snap action are used. ROTO-TROL 940 can be easily set on the job.

Write for Bulletins

Water Level Controls Division

HEALY-RUFF Company

783 HAMPDEN AVE., ST. PAUL 4, MINN.

"couldn't do without my

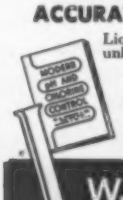
TAYLOR COMPARATOR

for pH, CHLORINE TESTS"

That's what water works operators say in plants all over the country. Taylor Comparators give fast, easy determinations of pH, chlorine, bromine, also complete water analysis. You can make determinations anywhere in plant since Taylor Sets are lightweight, small, no trouble to carry.

EASY TO USE Operate by colorimetric comparison method. No single standards to handle. Each complete set of standards in single plastic slide.

ACCURATE No chance of mechanical inaccuracy since all Taylor Liquid Color Standards carry an unlimited guarantee against fading!



GET THE FULL STORY from your dealer, or write for free book, "Modern pH & Chlorine Control". Gives theory and application of pH and Chlorine control, illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.

7308 YORK RD. • BALTIMORE-4, MD.

(*Continued from page 92A*)

Mr. Santandrea has been associated with the water works industry for more than 20 years. He was formerly with the Central Foundry Company, traveling through both the New England and New York territories. During the war he served in the European theater in the Transportation Corps.

Santandrea joined Warren Foundry in February 1952.

Simple New Unit Completely Handles Automatic Proportioning For Chlorinators

604

Fischer & Porter Co., Hatboro, Pa., has developed a new corrosion resistant automatic proportioning component for chlorinators to feed chlorine to water or sewage lines in a direct and preset proportion to the flow rate, however it may vary.

This new unit will handle the whole proportioning job under conditions existing at the majority of water and sewage installations. No expensive ratio controllers or complex transducers or pressure transmitters are required. It is operated by differential pressure coming directly from an orifice plate. Once an initial setting for a desired proportion of chlorine is made manually on the chlorine rate valve, the automatic proportioner takes over.

For use with the company's standard and high capacity vacuum-type, solution feed chlorinators, the automatic proportioner can be easily incorporated to make the conversion from manual rate adjustment either before shipment or after the chlorinator has been in use.

The automatic proportioning component replaces the differential pressure regulator which is used in manually controlled chlorinators. The new component, connected by both high and low pressure taps at an orifice in the main flow line, extracts differential pressure. The pressure is then converted to a force by means of a diaphragm. This variable force changes loading of the chlorine gas differential pressure regulator within the proportioning unit. In response, the pressure drop across the chlorine rate valve changes so as to vary the chlorine flow in direct proportion to the flow of water to be chlorinated.

Two proportioner models are available for standard and high capacity chlorinators. They are available in two standard differential ranges: 0-50 in. and 0-100 in. water column. Resistance to corrosion by moist or dry chlorine gas and to chlorine solution is assured by such construction materials as tantalum, Hastelloy "C," Uscolite, Teflon, Kel-F, Tygon and glass.

Neptune Acquires Revere Corporation

Neptune Meter Co., New York, N.Y., has announced acquisition of Revere Corporation of America in Wallingford, Conn., as part of its program of growth and diversification in the measurement field.

Revere, organized in 1940, is a manufacturer of electro-mechanical instruments for the measurement and control of liquids and temperatures. It also makes electronic toll recording equipment for highways and turnpikes.

Neptune has held a 49 per cent interest in Revere since 1951 and now has acquired the remaining 51 per cent interest in the New England firm with plants in Wallingford and Meriden, Conn.

Advanced Design Motor

605

U.S. Electrical Motors Inc., Los Angeles, Calif. has announced a completely new motor with numerous revolutionary features and conforming in every particular with NEMA specifications. By increasing precision of manufacturing processes, holding tolerances to closer limits and improving the electrical characteristics, this new motor, designated as Uniclosed, Type H, is more compact than previous models.

(*Continued on page 96A*)

how much does it cost to run the old model?

Even if you bought new today one of the old model chlorinators, you can actually scrap it right now and save money!

How can such a thing be?

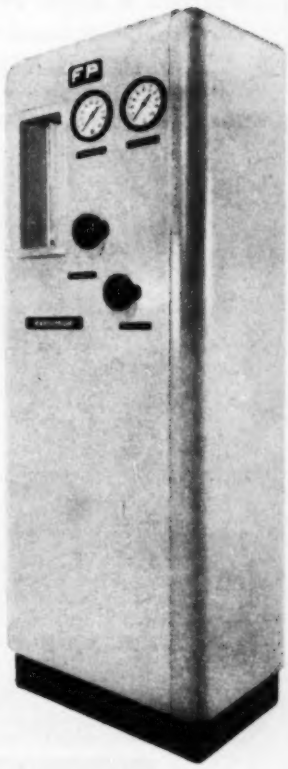
In hundreds of installations using **F & P** Chlorinators it has been proven conclusively that costs of operation and servicing are so much lower than old style chlorinators that it actually *costs money* right from the first day of operation to have an old style chlorinator.

Fischer & Porter designed this new chlorinator right from the floor up. New materials are used throughout to make it impervious to corrosion. Encased in a fibre-glass cabinet, the new **F & P** Chlorinator handles chlorine —in fully enclosed, tightly sealed, corrosion resistant pipes and components. It is the best, safest, most efficient, easiest operating chlorinator ever devised.

Right from the purchase price you save money on an **F & P** Chlorinator. And you save money every day thereafter, because you have less maintenance cost, less chance of breakdown with sky-high service charges, no need for multiple reserve units or scores of spare parts, no wasted chlorine gas lost through water seals.

As a top municipal official, as an ethical consultant, as a practical operating man—you must admit if all these things we say are true, you can't afford to ignore this new chlorinator.

It won't cost you a single penny to *get the facts* about the **F & P** Chlorinator. It will obligate you in no way. Why not write today?



FP

T.M., F&P CO.

complete process instrumentation

FISCHER & PORTER CO.

503 County Line Road, Hatboro, Pa.

LA-1005

18 YEARS EXPERIENCE SUCCESSFULLY MANUFACTURING CHLORINE FLOW METERING EQUIPMENT

Reader Service Card with your name, address, and item key number.
● If interested in equipment or literature mentioned below, mail a

BALDWIN ALUMINA SET

For quickly determining the residual alum in filtered water. The complete apparatus includes reagents, color standards and portable hardwood carrying case. The case protects the apparatus from possible contamination with alum dust. Complete with directions for use.

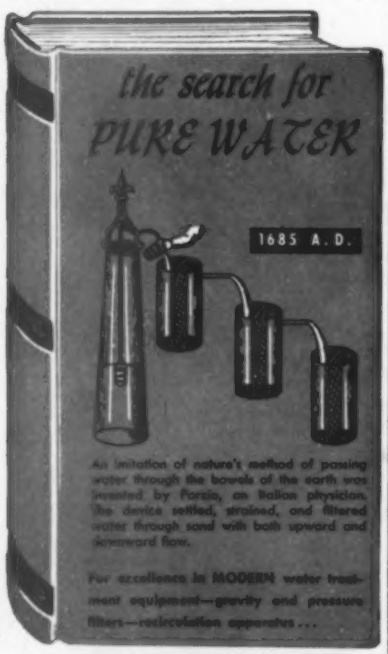
82-760 .....Each $65.00

Write

Phipps & Bird, Inc.

6th & Byrd St., Richmond, Virginia

(2385 Rhode Island Ave., N.E., Washington, D.C.)


the search for
PURE WATER
1685 A.D.
An imitation of nature's method of passing water through the bowels of the earth was invented by Porzio, an Italian physician. The device settled, strained, and filtered water through sand with both upward and downward flow.
For excellence in MODERN water treatment equipment—gravity and pressure filters—recirculation apparatus . . .

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

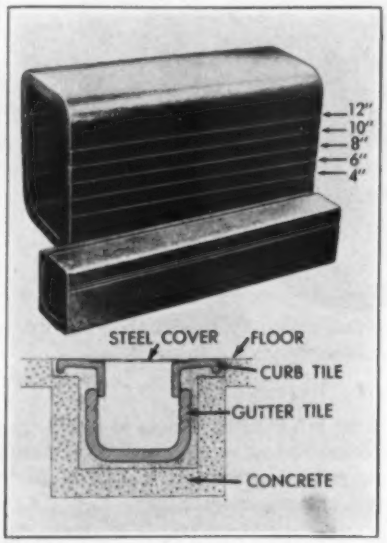
ROBERTS FILTER MFG. CO.

607 Columbia Ave.

Darby, Pa.

(*Continued from page* 94A)

One outstanding feature is its complete drip-proof design without increased cost. The frame is solid, one-piece cast iron and the stator is pre-wound. Frame sizes 182-184 are now available. By utilizing the interior space to better advantage, the motor is built more compactly so that the same horsepower can be embodied in less space. The end brackets are of entirely new design with air intakes so arranged as to prevent intrusion of water, yet allow liberal air flow into the motor for 2-way ventilation. Newly designed baffles within the air vestibules of the end brackets prevent splashings from entering and coming in contact with the windings.

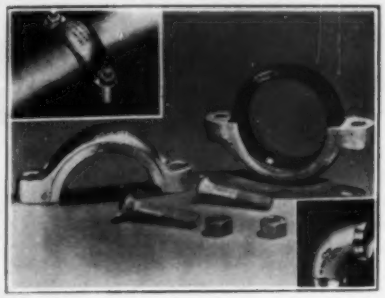


"Chemi-Drain" Channel Pipe Solves Corrosive Sewage Disposal Problems

606

The Logan Clay Products Co., Logan, Ohio, has announced that "Chemi-Drain," an entirely new kind of channel pipe designed by Dow Chemical Co. is now available for sloping drains and gutters in sewage plants and other corrosive service.

The new channel pipe is made of vitrified clay for permanent protection against corrosion by acids and other chemicals. "Chemi-Drain" is manufactured in double sections with five grooves or "kerfs" in each side so that the builder can divide the double sections into single sections of any desired depth from four to 12 inches. "Chemi-Drain" Curb Tile is used to cover the upper edges of the channel pipe, making the entire installation perfectly flush with the floor. The channel can be covered with a grill or solid floor plate.



Aluminum Couplings and Fittings for Groved Aluminum Pipe

607

Gustin-Bacon Manufacturing Company, Kansas City, Missouri has announced new aluminum Gruvagrip couplings and fittings for grooved aluminum pipe. These new products were developed as a result of increased production of aluminum pipe, which is readily available today.

Aluminum Gruvagrips and fittings are suitable for use wherever extremely light, high pressure pipe systems are needed. They are available in 2", 4", 6" and 8" sizes. The 8" aluminum Gruvagrip weighs less than 11½ pounds complete—half as much as a similar malleable iron coupling.

The new couplings automatically absorb expansion and contraction, shock, ground motion and vibration. They remain leakproof under end pulls up to 46,000 pounds; permit layout misalignment up to 3°; withstand temperatures between 200°F. and minus 65°F. They can be removed and re-used repeatedly. Aluminum Gruvagrips are suitable for permanent or temporary lines carrying air, vacuum, gases, water, oil and chemicals. The sealing gasket is of resilient synthetic rubber designed to resist the deteriorating effects of oil and chemicals.

Free-flowing aluminum Gruvagrip fittings are machined to standard grooving dimensions. They are 100% reclaimable; available in 90° elbows, 45° elbows, tees, caps and nipples.

Sveen-Pedersen Appoints Fritz Meyer President

Sveen-Pedersen Sales Corporation, Long Island City, N.Y., has announced the appointment of Mr. Fritz Meyer as President. Mr. Meyer is largely responsible for the development of the Sveen-Pedersen Flotation Saveall and its continued modernization.

Coincidental with this announcement is the appointment of Mr. O. F. Hutchinson as Director of Sales for

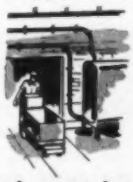
(*Continued on page* 98A)

Cheapest way to move pure water, gases, vapors, suspended solids

In jet well installation, Mills Plastic IV can be quickly fed by hand to any desired depth.

For irrigation, the pipe curves to follow trenches or contours, by-pass obstacles. Connections take 2 minutes.

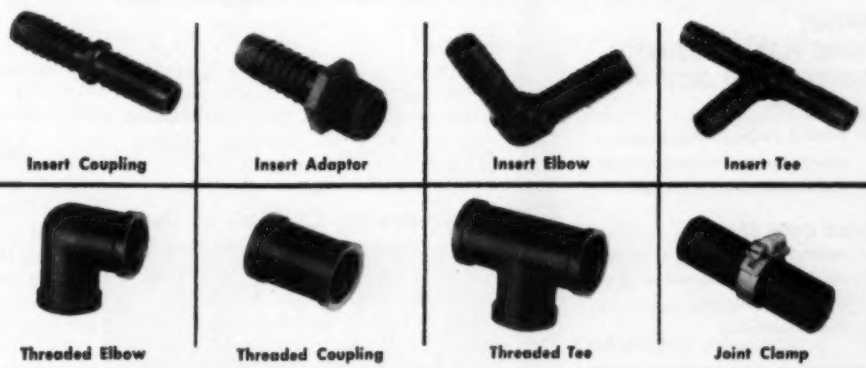
For water service lines, Extra Heavy pipe is available.



In food-processing and pharmaceutical industries, Mills Plastic IV carries gases, vapors, suspended solids, liquids.

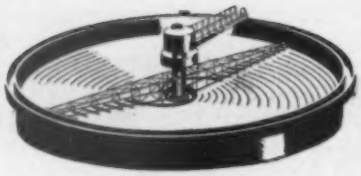
Mills Plastic IV polyethylene pipe never imparts odor or taste. It's ideal for carrying liquids for human consumption, and for hundreds of other uses. Costs less to install because, being flexible, the line may be allowed to seek its own floor. Comes in coiled lengths up to 400 feet. Polystyrene fittings and stainless steel clamps make connections simple between lengths, or to metal pipe. Continental's Mills Plastic IV is *strong*. It has a service life several times that of metal pipe weighing nine times as much. Ask your distributor for details, or write for new informative booklet.

FITTINGS MAKE LEAKPROOF CONNECTIONS QUICK AND EASY

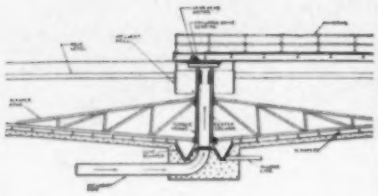


CONTINENTAL CAN COMPANY
MILLS PLASTIC PIPE DIVISION
SALES OFFICE
100 EAST 42nd STREET, NEW YORK 17, NEW YORK
Factory: 2930 North Ashland Avenue, Chicago 13, Ill.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.



Center-Feed Center-Discharge Clarifiers



One reason for the efficiency of Hardinge Clarifiers is the fact that the influent goes directly to a central stilling well and the underflow also is centrally removed. This promotes quick disposal of the heavier solids immediately upon entry—makes less work for the rotating sludge scrapers. The clear effluent overflows the tank periphery, where velocity is at a minimum. Bulletin 35-C-15

HARDINGE
COMPANY, INCORPORATED
YORK, PENNSYLVANIA · 240 Arch St. · Main Office and Works
New York · Toronto · Chicago · Hibbing · Houston · Salt Lake City · San Francisco

INCREASE SEWAGE PLANT CAPACITY WITHOUT CAPITAL COST!

WHAT IS IT?

- BIONETIC is a dry powder of preserved beneficial groups of micro-organisms that accelerate natural biological action.

WHAT DOES IT DO?

- BIONETIC can save money on sewage plant problems including odor control, increased sludge digestion capacity, and scum blanket control.

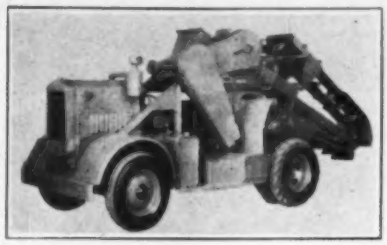
INTERNATIONAL ACCEPTANCE:

- BIONETIC is successfully used by hundreds of municipalities, industries, resorts, and institutions.

For FREE Literature Write:
A. J. Krell, technical director
Reliance Chemicals CORPORATION
P. O. BOX 6724 HOUSTON 5, TEXAS

(*Continued from page* 96A)

Sveen-Pedersen Sales Corp. Mr. Hutchinson brings to the company an additional sixteen years of experience in the industrial waste water treatment field. He was formerly with Bulkley Dunton Processes, Inc. and has one of the longest experiences with flotation clarification systems in this country.



3 Bucket Widths Available On New Trenchmobile

608

Parsons Company, Newton, Iowa, has announced increased bucket capacity with widths up to 16" for its Model 88 pneumatic-tire mounted Trenchmobile. The firm, a subsidiary of Koehring Company, Milwaukee, now offers a Model 88 with a choice of three bucket widths; 8, 12, and 16 inches.

Other improvements announced by Parsons include hydraulic boom hoist with positive down crowd and three-point suspension of the wheels from the Trenchmobile frame.

With the increased trench width, the range of usefulness of the Model 88 Trenchmobile will be extended. Workers can now get into the wider trench when installing pipes, tiles and conduits. Trenches for larger size pipes, tile and conduit systems are now within operating range of the machine.

Hydraulic hoisting and lowering of the digging boom provides positive down crowd when setting in the most severe soils. It also maintains grade quickly and accurately.

Administrative Changes at Dorr

The Dorr Company, Stamford, Connecticut, has announced the appointment of William E. Smith to the position of Assistant Sales Manager, with headquarters in Stamford. Concurrently with this appointment, Glenn O. Wilson, previously Manager of the Western Industrial Division in Denver, moves to Stamford and becomes Manager of North American Industrial Sales and William T. Marston takes over Mr. Wilson's former position as Manager of the Western Industrial Division, with headquarters in Denver.

Thomas Ball, Jr. Elected To Neptune Meter Board

Neptune Meter Company, New York, N.Y., has announced that Thomas Ball, Jr., president of Revere Corporation of America, Wallingford, Conn., has been elected to the board of directors.

Mr. Ball was named to the board at a meeting in Neptune's New York offices at 50 West 50th St., in the place of the late Rollo K. Blanchard, an official of the meter firm.

The election of Mr. Ball to the Neptune board follows the acquisition by Neptune last month of Revere Corporation, manufacturers of precision instruments for aviation and industry.

New Meter Housing

609

Ford Meter Box Company, Wabash, Indiana, has developed a new cast iron meter housing or "Yokebox" for shallow or warm climate settings.

Essentially, the Yokebox is a three piece housing consisting of a bottom pan with fittings, a slightly tapered oval shaped cylindrical housing and a lid.

The pan at the bottom is about a foot long, eight inches wide and five inches deep. The ends are equipped with connections that fasten to the water lines on the outside and form a solid meter yoke with valve on the inside. The Yokebox is made to fit either ⅝" or ⅝"x¾" meters.

The pan is set about a foot below the surface and is surmounted by the sidewall housing that forms a connection with the rim of the pan, and supports an oval shaped cover across the top. Holes in the bottom of the pan permit drainage.

The meter is lowered into position between the end fittings which are permanently aligned to take or release the meter with a minimum of effort. Actually, when the meter is placed it is "set" by means of a small hand wheel that forces the meter connections outward into the Yokebox fittings. Connecting or disconnecting of the meter is thus achieved in a

(*Continued on page* 100A)

U. S. BUREAU OF RECLAMATION SPECIFIES

Concrete Pressure Pipe

When the U.S. Bureau of Reclamation builds a pipeline, it must last a long, long time.

This is why the Bureau has specified concrete pressure pipe in many projects under its jurisdiction throughout the Western States. In the State of California alone, approximately 3,000,000 feet of concrete pressure pipe have been used in diameters ranging from 12″ through 84″, and for heads up to 650 feet. These jobs include the Coachella Valley Project, the Cachuma Project near Santa Barbara, both barrels of the San Diego Aqueduct, and the Central Valley Project.

Large pipe distribution systems, often calling for heads of 200 feet and over, are jobs for concrete pressure pipe. So, when your city is planning a water transmission system with either low or high heads be sure to get the facts on concrete pressure pipe.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

Concrete PRESSURE Pipe

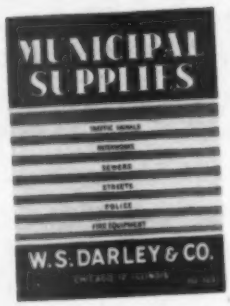
WATER FOR GENERATIONS TO COME

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

SKINNER-SEAL Split Coupling Clamp for dependable and lasting repair of broken mains. Sizes 2" to 24" inclusive. Write for catalog.

M. B. SKINNER COMPANY
SOUTH BEND, INDIANA



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A Filter Medium For All Purposes

ANTHRACITE EQUIPMENT CORP.
Anthracite Institute Building
Wilkes-Barre, Pa.

All correspondence regarding sales and engineering should be addressed to:

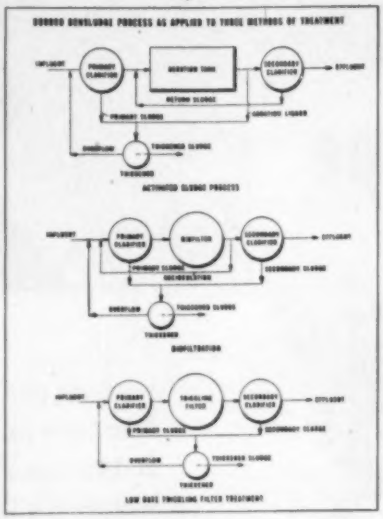
PALMER FILTER EQUIPMENT CO.
822 E. 8th St. Erie, Pa.
Engineers and Sales Agents

(*Continued from page* 98A)

moment without disturbing the water lines in any way.

The service valve sets at an angle so that it may be turned easily with a key on a handle that extends through the top of the housing. All servicing and meter readings are therefore achieved with a minimum of effort and inconvenience.

The Yokebox lid is made in two styles—with lock, and without. Both are flat across the top for flush-with-surface installation.



New Sludge Thickening Process

610

The Dorr Company, Stamford, Conn., has announced the development of The Dorrco Densludge Process for the continuous thickening of sewage sludge. Applicable to both primary and secondary sludge treatment the process entails continuous withdrawal of the sludges involved and controlled thickening of the mixture in The Dorr Densludge Thickener. Sludge volume is decreased up to 50% as compared with that produced by conventional methods with a resulting increase in digester capacity. Equally important, digester supernatant liquor is eliminated.

Use of The Dorrco Densludge Process places sludge removal from the clarifiers on a continuous basis and separates the two distinct and inimical functions of sewage clarification and sludge concentration. Continuous removal of dilute underflow permits clarification unaffected by the by-products of sludge thickening. By the concentration of dilute primary or mixed sludges in the Dorr Densludge Thickener without the necessity of undue concern for thickener effluent quality, a sludge is produced with about half the volume of conventional clarifier underflows. This decrease in sludge volume will increase the capacity of not only digesters but also other sludge handling facilities as well.

R. D. Butler

L. F. Maldeis

A.C.F. Appoints Two New Sales Engineers

American Car and Foundry Co., Valve Division, Detroit, Mich., has announced the appointments of Mr. Robert D. Butler and Mr. Lewis F. Maldeis as sales engineers for ACF valves.

Mr. Butler will cover the States of Florida, Georgia, Alabama, Mississippi, and Western Tennessee. He will make his headquarters at Jacksonville, Florida. Mr. Butler has had extensive experience as operating engineer with industrial plants in the southeastern section of the country. He was formerly employed with Holley-Edwards Sales, Inc., at Jacksonville.

Mr. Maldeis will cover the general Pittsburgh, Pa. area, including part of Ohio and West Virginia. He will make his headquarters at Pittsburgh, Pa.

A graduate of Baltimore Polytechnic High School, Mr. Maldeis attended night classes in mechanical engineering at Johns Hopkins McCoy College, Baltimore, Maryland. His former employment was with the Glenn L. Martin Company of Baltimore. Prior to coming to ACF he was with the Bethlehem Steel Company at Sparrows Point plant, where his duties included instrument and control mechanisms.

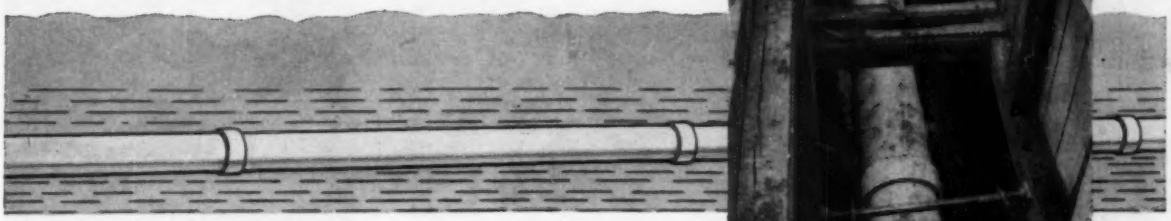
Heavy Duty Pipe Wrenches

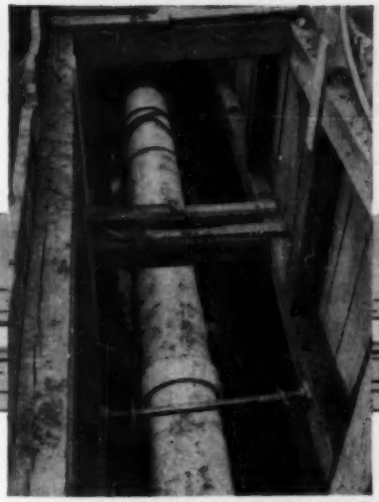
611

Toledo Pipe Threading Machine Co., Toledo, Ohio has announced a new line of Toledo heavy duty Pipe Wrenches specially designed for rugged duty and hard, tough work. The new wrenches are backed by the manufacturer's unconditional guarantee. This means that the user is fully protected against expense if the wrench housing or hook ever breaks

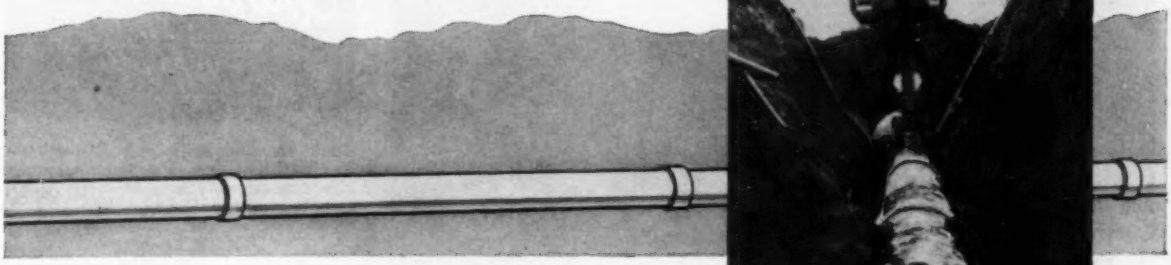
(*Continued on page* 102A)

Low land, flat grades?
High water table?





Rolling land?
Excavation problems?



Whatever the problem—

Transite® Sewer Pipe

speeds installation, cuts operating costs

IN a wide range of conditions, Transite Sewer Pipe and its Ring-Tite Coupling provide installation and operational *plus-advantages* that add up to important cost savings.

[**Flow Coefficient n=0.010**] For instance, with Transite Sewer Pipe, specified velocity of flow can be attained at a minimum grade. Initial savings may also be reflected in smaller pipe sizes. Its unusually low flow coefficient (n=0.010 derived from the Manning formula) makes this possible. This means less cubic yards of excavation, and may also mean . . . elimination of pumping . . . location of treatment plant at higher elevation . . . lower installation costs especially if in wet or ground-water conditions.

[**Tight Joints**] Where ground water conditions exist (due to a constant water table or during seasonal rains) Transite's Ring-Tite Couplings are *tight* . . . thus treatment-plant dollars are spent to treat *normal* sewage only, not excessive and unnecessary infiltration.

[**Strength**] Made of asbestos and cement, Transite Sewer Pipe is strong and durable. It withstands heavy load stresses, eliminates expensive cradling in many cases. It is available in two strength classifications.

Transite Sewer Pipe is easily handled, quickly assembled and lowered into trench where it adjusts more accurately to line and grade. The Ring-Tite Couplings are easily and quickly pulled, forming tight, flexible joints that *start* tight and *stay* tight.

For your copy of TR-94A, the helpful widely used Sewer Design Flow Chart, based on the Manning formula, write Johns-Manville, Box 60, New York 16, N. Y.

Johns-Manville TRANSITE SEWER PIPE

THE PIPE WITH THE TIGHT JOINTS

- *Permanence*
- *No tuberculation*
- *Equal distribution*
- *Uniform filtration*
- *Low loss of head*
- *Acid, alkali-resistant*
- *Long life*

You get ALL these advantages with

LEOPOLD

Glazed Fire Clay

TILE FILTER BOTTOMS

Today, in more than 250 plants with a daily capacity of over 1¼ billion gallons, Leopold Duplex Filter Bottoms are providing dependable, economical service with minimum maintenance.

Made of highest quality de-aired fire clay—vitrified and salt glazed, the Leopold Filter Bottom requires only a shallow depth of small sized, inexpensive filter gravel to support the filtering medium. Further, the laterals and distributing blocks are all combined in one strong permanent unit that will last indefinitely.

Adaptable to any rectangular filter unit, the Leopold Glazed Tile Filter Bottom is designed to successfully meet all underdrain requirements.

Each Leopold filter block is about 2 sq. ft. in area—weighs approximately 100 pounds.

Complete Water Purification and Sewage Plant Equipment...

- **DRY CHEMICAL FEEDERS**
- **FILTER OPERATING TABLES**
- **MIXING EQUIPMENT**

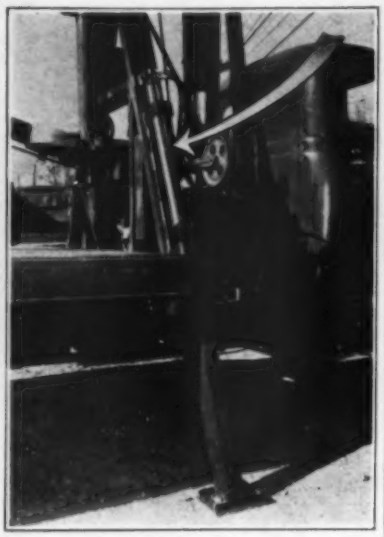
Want more details? Write us today.

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

(*Continued from page* 100A)

or distorts—in which case the company guarantees to replace it free.

Features of the new wrench include an easy-action nut and single spring that assure quicker, easier setting of jaws . . . improved handle design that increases strength and provides better hand-grip . . . handy pipe scale on hookjaw. The handle is painted red, in keeping with the Toledo "family colors" of red and black used on all models of the company's pipe tools, power pipe machines and power drives. The new wrenches are available in a complete range of sizes—6" to 48".



Hydraulically-Operated Outriggers

612

Pitman Manufacturing Company, Kansas City, Missouri, has announced that hydraulically-operated outriggers are now available as optional equipment on the Model "B" Pitman Hydra-Lift, truck-mounted crane with loadline capacity of 6400 pounds and power-swinging boom which telescopes from 12 to 22 feet.

With the outriggers hydraulically powered, an operator can raise and lower the outrigger legs instantly simply by manipulating controls at his regular operating station. The manufacturer states this makes it possible to speed up any job where outriggers must be used frequently; such jobs as stringing pipe, pulling paving forms and unloading materials at a number of different points around a job site.

Hydra-Lift, which has been on the market about 2½ years, requires but 40 inches behind the cab of a truck, leaving the balance of the chassis for normal hauling purposes. Hydraulic

In hydrants, too, it's important to have

Unobstructed flow

Look at a cutaway view before you buy any hydrant! You'll be surprised how few provide an absolutely unobstructed waterway! And *no one* but Iowa offers you *all* this and much more—

1. Provides full and unobstructed waterway for maximum flow of water from main to nozzle.
2. All internal working parts removable through top of hydrant for periodic inspection.
3. Superintendents find Iowa hydrants easy to keep in "tip-top" operating condition—no special tools required.
4. Main valve holds tight in closed position so that—should hydrant be damaged—no loss of water, or flooding, will occur.
5. Two-piece operating nut eliminates binding or distortion of working parts (sometimes caused by expansion and contraction)—makes Iowa hydrants easy to open and close at all times.
6. Complete drainage by sure acting drain, prevents freezing.
7. Fully bronze mounted throughout—meet all requirements of A. W. W. A.—have proved their ruggedness and reliability to waterworks men everywhere.
8. Available with any type of connection.

Get ALL the facts! Write

IOWA

VALVE COMPANY

201-299 N. Talman Ave., Chicago 80, Ill.

A subsidiary of James B. Clow & Sons

power swings the boom 180 degrees, lifts it through an arc of 100 degrees. This compact, versatile crane, asserts the manufacturer, has proved a time and labor-saving tool for handling gas, water and sewer pipe, paving forms, structural steel, building materials, poles, transformers, pre-cast concrete and many other similar loads.

Beckman Expands Field Service

Beckman Instruments, South Pasadena, Calif., has announced that five new field repair specialists have been assigned headquarters in the U.S. and Canada.

The service men—all qualified electronics maintenance experts—will conduct on-the-spot servicing of Beckman equipment in laboratories and industrial plant installations. Their assignment follows an intensive 12-week factory training course in California.

Service headquarters are located at Los Angeles, Calif., Washington, D.C., Mountainside, N.J., Houston, Texas, and Toronto, Canada.

Executive Elections At A. M. Byers Co.

A. M. Byers Company, Pittsburgh, Pa., has announced that A. B. Drastrup has been elected by the board of directors as executive vice president.

Mr. Drastrup became associated with Byers in 1931, and has had broad experience in virtually all of the company's operations. Since 1946 he has been manager of steel sales. Three years ago he was also named assistant to the president.

The elections of J. F. Byers, Jr. and B. M. Byers as vice presidents of the company also took place at the board meeting. The former has been with the company since 1937, and has been a director since 1939. He has been assistant to the president since 1949.

B. M. Byers, the new vice president of sales, has been general manager of wrought iron sales for the past year. He has been with the company since 1940 and has been a director since 1948.

All other officers of the company were reelected.

Builders-Providence Appoints Glenn Hawkins

Builders-Providence, Inc., Division of B-I-F Industries, Inc., Providence, R.I. has announced the appointment of Glenn Hawkins as an Application Engineer. In this posi-

(*Continued on page* 104A)

Air-handling specialists for 100 years

Starting in 1854 with the invention of the Rotary Positive Blower by our founder, Francis M. Roots, our company's services to industry were, for many years, devoted exclusively to air-handling problems.

As industry developed new applications of gases for fuels and chemicals, it was a natural step for us to move into this field because the general principles of moving and measuring air and gas are so closely similar.

Thus, Roots-Connersville service has been widened to include seven basic types of equipment . . . all devoted to the handling of either gas or air. The most recent development has been the new, amazingly efficient Spiraxial Compressor, first marketed in 1953.

So, for a century we have been engaged exclusively as specialists in handling gas and air. That is our only business. We like to think that this is one of the important reasons why R-C equipment has been so widely accepted in every industry where processing involves the movement of air or gas.

The growth which we have experienced over 100 years could not have been possible without the loyal support of our many thousands of customers. We thank them for this evidence of good will—and we offer the same high type of equipment and service to any industry that has a problem of moving gas or air.

Reg. U.S. Pat. Off.

ROOTS-CONNERSVILLE BLOWER

BLOWER BUILDERS SINCE 1854

A DIVISION OF DRESSER INDUSTRIES, INC.
54 Mount Ave. • Connersville, Indiana

Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiraxial Compressors

Old Sewer Gets New Life with "GUNITE"

The picture at the left shows an old concrete storm sewer in Washington, D.C., badly disintegrated and honeycombed. Flow value was low due to roughness. This sewer was reconditioned by chipping away the worst areas, sandblasting the entire surface and applying a "GUNITE" lining.

The smooth brush finish increased its capacity sufficiently to meet all requirements, making it unnecessary to build a new sewer. The completed job is shown at the right.

Many money saving applications of "GUNITE" are described in our illustrated Bulletin C2400. Request on your letterhead will bring you a copy.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.

MANUFACTURERS OF THE CEMENT GUN

Looking for lower costs in clarifying water?

Let N-Sol® Activated Silica* be your answer to reduced chemical costs and higher quality water. With N-Sol, one mill uses only one-tenth as much alum to treat river water at high turbidity; it also greatly reduces manpower.

Request free samples of N Silicate and directions for jar tests on your own water supply.

*N-Sol is prepared conveniently in your plant with N Sodium Silicate and a reactant chemical. No charge for license under our N-Sol Process Patents.

Philadelphia Quartz Company
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Philadelphia 6, Pa.

N-Sol® Processes
PQ® SOLUBLE SILICATES

(*Continued from page* 103A)

tion, Mr. Hawkins will assist R. W. Pearce, Manager of Chlorinizer Sales, on projects in the chlorination of water, sewage, and industrial wastes.

Mr. Hawkins, a graduate of Georgia Institute of Technology, has recently been associated with American Water Softener Co. Prior experience included service as District Sanitary Engineer with the U. S. Navy in Washington, D.C., and as Sanitary Engineer with the U. S. Public Health Service in Washington, and the Standard Oil Co., of New Jersey, in Venezuela.

Pacific Flush Tank Moves Eastern Office

Pacific Flush-Tank Company, Chicago, Illinois has announced that the Company's Eastern office, formerly located at 441 Lexington Avenue, New York City, has moved to 225 Westchester Avenue, Port Chester, New York. The new telephone number is Po 5-6212.

De Laval Appoints Representatives in El Salvadore and Costa Rica

De Laval Steam Turbine Company, Trenton, New Jersey has announced the appointment of La Casa Castro of San Salvador, El Salvador, C.A. as exclusive representatives for the company's products in the Republic of El Salvador.

At the same time it was announced that Francisco Font of Apartado Postal 1528, San Jose, Costa Rica, C.A. was appointed exclusive representative in the Republic of Costa Rica.

Both new representatives will handle all De Laval products, which include steam turbines, centrifugal pumps, IMO pumps, speed reducers, couplings, compressors and blowers.

Beckman Opens New European Office, Manufacturing Plant

Beckman Instruments, Inc., South Pasadena, Calif., has announced the opening of a branch assembly plant and European Sales headquarters in Munich, Germany.

Founded as a corporation under German law, the new Beckman factory will be staffed chiefly by Europeans, with some key personnel transferring from the company's U.S. plants. Production initially will be limited to portable pH (acidity) meters and quartz spectrophotometers.

The European Sales and Service Office will cover 18 countries over-

seas—including the United Kingdom, Germany, France, Italy, Spain, Switzerland, the Netherlands and Scandinavian countries.

Harold Zander, a U.S. Citizen, will direct this office, assisted by Friedrich Schroeder and Joachim De Vos, graduate engineers who have received intensive training at various Beckman factories in this country.

Literature & Catalogs

Diesel Engines

613

The National Supply Company, Engine Division, Springfield, Ohio, has just published an 8-page illustrated bulletin describing **Lister Stationary Diesel Engines,** five models of 9 to 54 bhp. with one to six cylinders (3.75x4.5 in.). Design features, specifications, and dimensional diagrams of five models of 9 to 54 bhp. with one to six cylinders are given.

Pneumatic Signal Transmitter

614

Hagan Corporation, Pittsburgh, Pa., has just issued a bulletin that illustrates and describes the **Pneumatic Signal Transmitter** designed especially for use with the Hagan Ring Balance Meter.

Using a schematic diagram of the operating mechanism, the booklet explains how the speed, accuracy and stability of the Transmitter, in combination with the versatility of the Hagan Ring Balance Meter, provide an instrument easily adaptable to an extremely wide variety of metering and control applications. These include control installations requiring automatic reset, remote adjustable set point and derivative rate action.

Sump Pumps

615

Johnston Pump Company, Pasadena, California, has just published a bulletin on **Johnston Unit-Line Sump Pumps.**

This attractive 2-color, fully illustrated bulletin gives construction details, head and capacity tables, dimensions and other data on the complete line of pumps. According to the bulletin the Unit-Line Sump Pump is a pre-engineered packaged line from which a pump can be selected for existing conditions or for new construction.

HOW TO LOCATE WATER LEAKS

...with Simplex Pitot Equipment

WHY not decrease your load and stop pumping to waste? Locate the hidden leaks which waste thousands of gallons per day per mile of main . . . far more than usually guess-timated!

Locating these leaks with Simplex Pitot Equipment costs only a tiny fraction of the value of the water being wasted. You get accurate flow records with minimum effort . . . valuable data that will help you to reduce "unaccounted-for water" to a minimum.

PITOT ROD

Simple, rugged and lightweight. Easily installed on any pipe or main. Special clamp holds tube firmly in position against water pressure.

Low coefficient gives high differential pressure for greatest accuracy.

MANOMETER

Quickly connects to a Simplex Pitot Rod with flexible tubing. You then have a simple, sensitive and inexpensive instrument for indicating rate of flow.

Can be used for wide flow ranges . . . low or high.

PITOT RECORDER

Connects easily to Pitot Rod. Eight-inch chart records flow data. Simple and rugged construction . . . no delicate mechanisms . . . yet sensitive and accurate.

Sturdy carrying case. Leveling feet. Reliable 7-day clock movement for chart. Accurately calibrated.

Get the Facts!

Free 20-page Technical Bulletin 1300. Full instructions for use and care of Pitot equipment. Seven pages of helpful formulae, tables, curves. Write to Simplex Valve & Meter Co., 6743 Upland St., Philadelphia 42, Pa.

SIMPLEX®

VALVE AND METER COMPANY

"Every individual connected with water purification or sewage works should subscribe to this publication. I have introduced it to a host of friends in this field"

Testimonials such as this from subscribers to WATER & SEWAGE WORKS really tell the story. The man who reads and uses the magazine as an aid in his work knows how much it will benefit other workers in the field.

The great REFERENCE & DATA issue alone is worth more than the yearly subscription rate. In it you will find formulae, charts and illustrations covering information not obtainable in any other one source.

Supply of 1954 REFERENCE & DATA number is limited. If you are not a subscriber send your order today!

WATER & SEWAGE WORKS
185 N. Wabash Ave.
Chicago 1, Ill.

You may enter my order for 1 yr. @ $2.00 ☐
☐ Include R&D issue 2 yrs. @ $3.00 ☐
Check enclosed ☐

Send bill to .....
My title is .....
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(Add $1.00 per year for foreign postage)

- *If you are interested in the water field only you get all the authoritative data on this subject.*
- *If you are interested in sewage problems only you are kept fully informed and given much help in this field.*
- *If you are interested in both subjects you get all the information in this one monthly magazine.*

Facts About Electric Power Apparatus

616

Electric Machinery Mfg. Company, Minneapolis, Minnesota, has available a 36-page booklet of **Facts About Electric Power Apparatus.**

This profusely illustrated booklet gives apparatus facts and application facts on large induction motors; synchronous motors; generator sets; adjustable speed magnetic drives; motor controls; engine-driven A-C generators; turbine-driven A-C generators; water wheel-driven A-C generators and generator switchgear. Both water and sewage works applications are shown for this equipment.

Safety Tread and Threshold Catalog

617

Wooster Products, Inc., Wooster, Ohio, has just released a new 12-page catalog on **Safety Treads and Thresholds.**

The book is sectioned showing a complete variety of treads and metal in which they are available. Full size cross-sections are illustrated. The Safe Groove and Abrasive Cast Treads; Extruded Cast and Abrasive Thresholds and miscellaneous accessories such as plates, curb bars, window and elevator sills, etc. Complete explanatory installation sketches are also shown.

Anthrafilt

618

Palmer Filter Equipment Company, Erie, Penna., has available a booklet on **Anthrafilt, Hard Coal Filter Medium.**

This 12-page booklet, by means of a question and answer technique, and line drawings, covers the advantages, costs, what it does, etc. of Anthrafilt. Pages 8 and 9 give a list of municipalities and industries using Anthrafilt. A filter data questionnaire sheet for recommendation of Anthrafilt filter media is also enclosed.

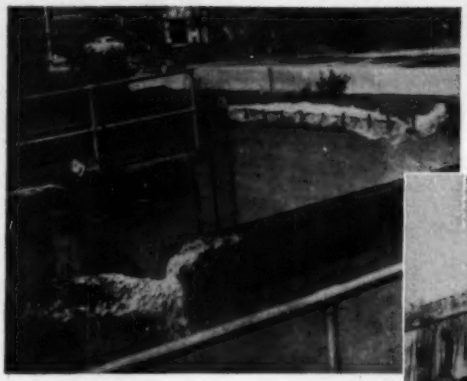
Filter Bed Agitators

619

Palmer Filter Equipment Co., Erie, Penna., has available a booklet on **Palmer Filter Bed Agitators.** The booklet gives general information, specifications and installation data regarding the application of the agitators, or rotary surface wash in vertical and horizontal pressure filters of the round, square and rectangular open gravity type.

(*Continued on page* 109A)

THOROSEAL *Restored* this Filtration Plant



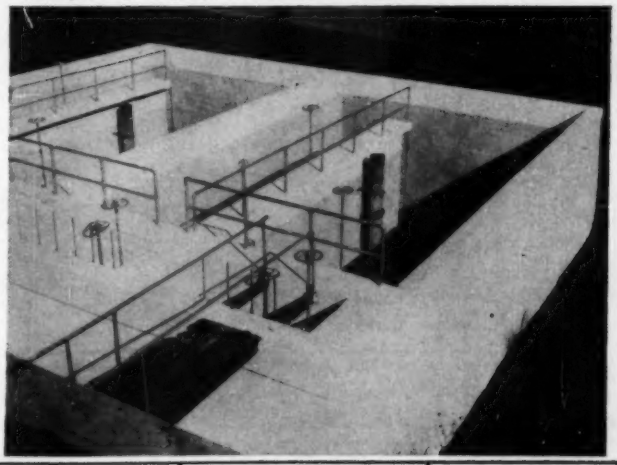
BEFORE

Example of complete break-down of masonry, due to penetration of water into body of concrete and action of frost in damp masonry.

It is amazing how THORO System products will correct a condition, such as shown in photograph. Concrete was sandblasted to remove all disintegrated material to sound concrete surface and reinforcing rods. Patching was done with THORITE Patching Mortar, bringing blistered areas to true and even lines, followed by two applications of WHITE THOROSEAL for protection.

AFTER

At minimum cost, almost ⅓ the cost of other methods, concrete restoration, patching and surface protection was completed with THORO System products on Filtration Plant in Keyser, West Virginia. Contractor: Standard Construction & Waterproofing Company, of Cumberland, Maryland.



WATERPLUG	THOROSEAL	QUICKSEAL
To Stop Leaks	To Seal Surface	For Beautiful Finish

Our 20-page Brochure describes, in detail, how The THORO System products can benefit you in your construction plan. Send for brochure today, which shows methods of application and how to use the material.

Standard Dry Wall Products

Box X, NEW EAGLE, PENNA.

No words needed...

Before ever he speaks a word, he asks your love.
In it begins the security he will need forever.

The whimper when he's hungry, the sigh of peace when he's fed and warm, the cuddle of his sleepy body—all these tell a need that never ends.
The need that none of us outgrows: to be safe and secure in body and heart as long as we live.

The security of our homes is a universal dream. That each of us is free to make secure the lives of those we love, is our peculiar privilege.

As we take care of our own, we also take care of America. Out of the security of each home rises the security of our country.

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WATER & SEWAGE WORKS

(*Continued from page* 107A)

It covers: use and operation of Palmer filter bed agitators; specifications for Palmer filter bed agitators; data sheets; data on installation; recommended end caps for various conditions; installation sketches; and typical prints of actual installations.

Pipe Tool Catalog

620

Beaver Pipe Tools, Inc., Warren, Ohio, has recently produced a new, 16-page **Power Machine Catalog.**

Attractively printed in green and white, the new catalog covers features, dimensions, operating capacities, users, ordering specifications, dies available and accessories for five pipe machines and power drives, plus Beaver's new "55" Universal Nipple Chuck.

Beaver Models "A," "B," "E" Pipe and Bolt Machines and Models "D" and "C-1" Portable Power Drives are fully described and shown in color. Scores of pen and ink sketches show various adaptations and features of the equipment.

Water Conditioning and Waste Treatment

621

American Water Softener Co., Philadelphia, Pa., have issued a new bulletin called **"American Reactors"** describing their Three-Stage Reactors for softening or clarifying surface waters for process, industrial or municipal applications and for the treatment of industrial waste water for re-use or for the reduction of stream pollution. They are recommended for all precipitation and absorption processes involving cold water.

Also described in the bulletin are other uses for lime or lime-soda softening of hard water for municipal, industrial and process applications, dealkalization and coagulation of surface water as a pretreatment to ion exchange or hot process softeners, or for removal of silica from the water by adsorption with ferric hydroxide magnesium oxide or other hydroxides in the sludge.

Metal Chain Bulletin

622

Chain Belt Company, Milwaukee 2, Wisconsin, has just published a new bulletin describing **Rex Z-Metal Chain.** According to the bulletin Rex Z-Metal Chain is made of special heat-treated, alloyed ferrous metal. It has physical properties equal to the better grades of steel, yet is reasonably low in cost. It resists corrosion and abrasion and is considerably harder than malleable iron. It is unusually ductile and is readily machinable. Pins of Rex Z-Metal Chain are of heat-treated high-carbon steel.

The new bulletin describes the user benefits of Rex Z-Metal Chain. Reports of laboratory tests and field applications verify the claims made for this metal. A pictorial presentation of available Z-Metal Chain is included.

Dual Fuel Engine Bulletin

623

Worthington Corporation, Harrison, N.J., has announced a new bulletin on **Dual Fuel Engines** for R.E.A. Generating Stations, Sewage Disposal, Private Utility, Municipal Power, Pipeline Pumping, Industrial Power, and Irrigation and Drainage.

In the thirty-six page book, are photographic examples of each application, together with vital statistics, case histories and comments on fuel consumption.

Also, a page or more is devoted to each feature; the Dual Plunger Fuel Injection Pump; the Automatic Fuel Switcher for automatically changing from gas to oil fuel operation; the Automatic Thermal Air control; and the Micro-metering Gas Valve which accurately controls fuel gas supply to individual power cylinders.

Tank Protection System

624

General Paint Corp., San Francisco, Calif., has released a four-page, two-color illustrated bulletin describing the complete **General Paint Tanx Protection System** for those interested in exterior surface protection for tanks, storage vessels and tank cars.

The publication describes primers, coatings and trim recommended in the complete system, and complete data on surface preparation, priming and application of finish and trim coats.

Water, Sewage and Trade Waste Equipment

625

Hardinge Company, Incorporated, York, Pennsylvania, has released a 6-page, color brochure describing its line of **Water, Sewage and Trade Waste Treating Equipment.** Numer-

(*Continued on page* 111A)

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- ☐ Have you arranged to have a Bloodmobile make regular visits?
- ☐ Has your management endorsed the local Blood Donor Program?
- ☐ Have you informed employees of your company's plan of co-operation?
- ☐ Was this information given through Plant Bulletin or House Magazine?
- ☐ Have you conducted a Donor Pledge Campaign in your company?
- ☐ Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?

Remember, as long as a *single* pint of blood may mean the difference between life and death for *any* American . . . the need for blood is *urgent!*

(*Continued from page* 109A)

ous installations of Hardinge Circular Clarifiers are illustrated and the various applications of this equipment are discussed. Also included are several typical flow sheets and a brief description of auxiliary apparatus such as digestors and flocculating equipment.

Rotameter Flow Handbook

626

Brooks Rotameter Co., Lansdale, Pa., has announced a complete manual covering **Rotameter** applications, size selection, design and materials data, flow correction, operating and maintenance instructions, etc. The answer to a long-standing need for a simplified, comprehensive guide to Rotameter procedure. Countless hours in engineering time saved due to many short cuts in calculations usually necessary in size selection and correction for varying conditions.

Six Chapters—each a complete unit in itself—covering all phases of Rotameter applications in laboratory, research and industrial pilot plant and allied processing fields.

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The Flow Handbook costs $20.00 and is serial numbered and registered in owner's name and will be kept up to date with supplementary data to existing chapters at no additional cost. Two hundred and twenty-five pages handsomely bound in a sturdy 2½" post-type cover.

Dorrco Aldrich Perifilter System

627

The Dorr Company, Stamford, Conn., has announced the availability of a new six-page, two-color bulletin, **"The Dorrco Aldrich Perifilter System."** It describes the physical characteristics, types, and sizes of this new water treatment System as well as its instrumentation, operation, applications, and advantages. Also included are wash drawings and photographs of the System and its individual components.

According to the bulletin the Dorrco Aldrich Perifilter System combines for the first time in a single unit pre-treatment and filtration of municipal and industrial water supplies. It is composed of a pre-treatment mechanism surrounded by an annular rapid sand filter. Also included are hydraulically or motor operated control valves, filter rate controllers, instruments, and panel boards necessary for manual or automatic operation and control.

Engines for Sewage Plants

628

Worthington Corporation, Harrison, N.J., has just published a graphically illustrated bulletin on **Engines for Sewage Plants,** containing design information, comparison fuel analysis charts, selection information, engine ratings, as well as application photographs.

The bulletin also covers compressors, vacuum pumps, centrifugal and rotary pumps, and equipment for handling raw sewage, effluent and sludge.

Grating Flooring and Treads

629

Irving Subway Grating Co., Inc., Long Island City, N.Y., has announced publication of its new catalog on **Irving Gratings.** A comprehensive easy to use and read Catalog contains illustrations, descriptions and complete engineering data on grating-flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial and power plant and refinery walkways, stairways, driveways, trucking aisles; ship catwalks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring, expansion joints, catch basin covers; bridge decking.

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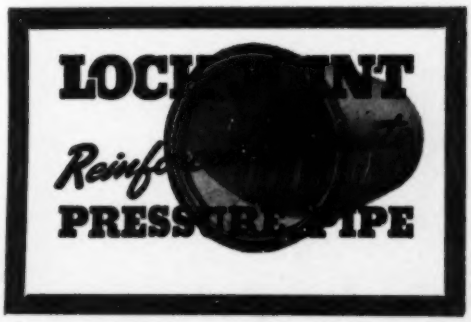

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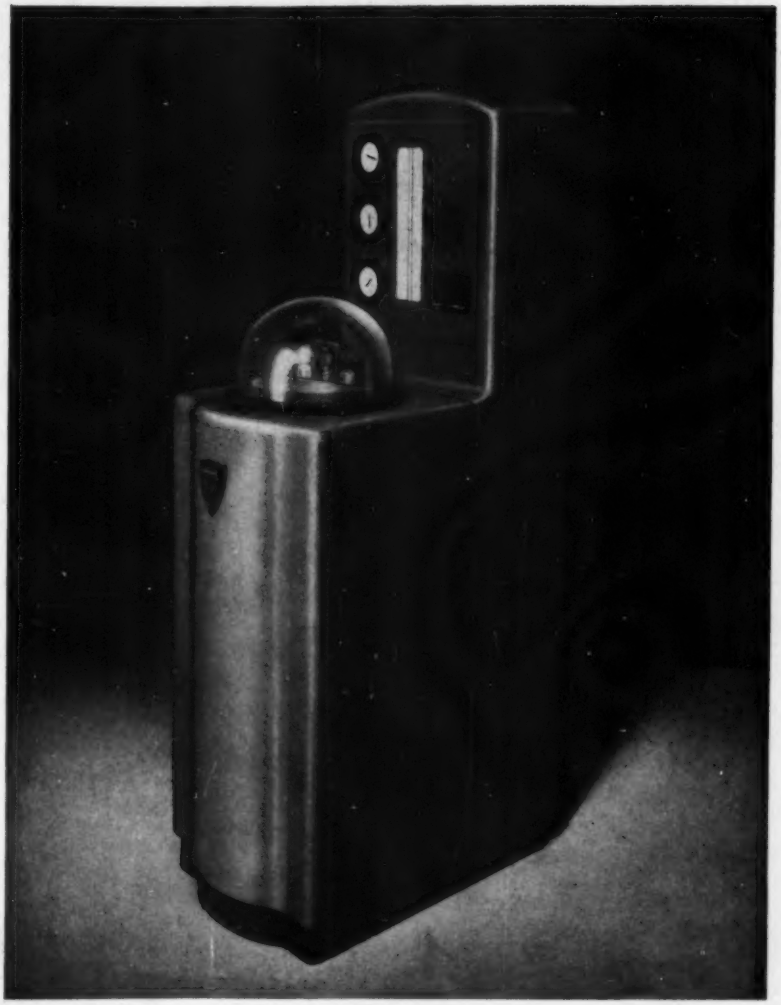

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